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# CONDITION SURVEY OF LOCK NO. 2 MONONGAHELA RIVER

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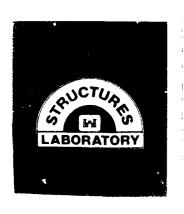


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A condition survey was performed at Locks and Dam No. 2 on the Monongahela River in Pennsylvania to determine the extent of possible concrete damage, processes causing distress of the concrete, selected physical and mechanical properties of the concrete and foundation materials, and the ability of the concrete to perform satisfactorily under anticipated conditions of future service. The field investigation included a visual inspection of the structure to determine the general condition of the concrete, and drilling operations to recover concrete and foundation core. Results of the field investication and laboratory tests indicated that the concrete is generally in good condition, with dissolutioning of carbonate aggregate particles giving the appearance of exposed aggregate to the concrete. Some popouts, scaling, and spalling are also present. The near surface concrete contains some cracking not associated with any apparent chemical reaction. The cracks do not appear to be active. The concrete in this structure should remain serviceable for a period of 50 years from the date of this investigation.					
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#### PREFACE

The work described in this report was performed for the US Army Engineer District, Pittsburgh, by personnel of the US Army Engineer Waterways Experiment Station (WES). The work was authorized by DA Form 2544, No. ORPED-85-31, dated 16 May 1985.

The testing program was accomplished under the direction of Bryant Mather, Chief, Structures Laboratory (SL), WES, and Mr. John M. Scanlon, Jr., former Chief, Concrete Technology Division (CTD), and Mr. Ken Saucier, Chief, CTD. All of the core drilling was conducted by WES under the direction of Mr. Mark A. Vispi, Chief, Exploration Group. Laboratory work in the CTD was done with the assistance of Mr. Joe G. Tom, Mrs. Joyce C. Ahlvin, and Mr. J. Pete Burkes. This report was prepared by Messrs. Wong and Stowe with assistance from Mrs. Ahlvin and Mr. Tom.

COL Dwayne G. Lee, CE, is the Commander and Director of WES. Dr. Robert W. Whalin is Technical Director.

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EXHIBIT 1: PHOTOGRAPHIC RECORD OF DRILLED CORE\*

<sup>\*</sup> On file with US Army Engineer District, Pittsburgh.

# CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report an be converted to SI (metric) units as follows:

Multiply	By	To Obtain
degrees (angle)	0.1745329	radians
feet	0.3048	metres
feet per second	0.3048	metres per second
inches	25.4	millimetres
miles (US statute)	1.609344	kilometres
pounds (force) per square inch	0.006894757	megapascals
pounds (mass) per cubic foot	16.01846	kilograms per cubic metre
tons (force) per square foot	0.09576052	megapascals

# CONDITION SURVEY OF LOCK NO. 2 MONONGAHELA RIVER

PART I: INTRODUCTION

# Project Description

1. The following description of the project is taken from the first periodic inspection report of Locks and Dam 2 (US Army Engineer District, Pittsburgh, 1973). Locks and Dam 2 are located on the right bank of the Monongahela River 11.2 miles\* above the mouth at Pittsburgh (Plate 1). The dam is a fixed crest weir with crest at elevation 718.7; the dam is part of the original structure constructed between 1902-1906. Of the existing locks, the 56-ft by 360-ft riverward lock was reconstructed riverward of the original locks and completed in 1951 using the original landward chamber to maintain traffic. The 110-ft by 720-ft landward chamber was constructed after completion of the new riverward chamber which was used to maintain traffic and was completed in 1953. A general plan view and cross-sectional view of the locks are presented in Plate 2. This plate is also taken from the first periodic inspection report.

#### Background

2. The Waterways Experiment Station (WES) was requested by the US Army Engineer District, Pittsburgh (ORP for Ohio River, Pittsburgh), to conduct a condition survey at Lock and Dam No. 2. The ORP provided design, construction, operation and maintenance information and data on the structures. The First Periodic Inspection Report dated 25 August 1973 and the Second Periodic Inspection Report dated 15-16 June 1978 were reviewed for information pertinent to the concrete. The survey consisted of a site inspection to determine the general condition of the concrete and to locate borings. Following the site visit, it was recommended that a crack survey not be performed at this time due to the relatively good condition of the concrete and the lack of

<sup>\*</sup> A table of factor for converting non-SI units of measurement to SI (metric) units is presented on page 4.

cracking. The drilling program was approved by the District while some of the boring locations were approved during the drilling operation.

# Objective

3. All efforts were limited to locks structure. The condition survey of the much older dam was not part of this effort. The dam is submerged at all times and did not lend itself to a detailed condition survey without major efforts to dewater the structure. The dam will be addressed by the District. The objectives of the condition survey are: (a) Identify the processes or materials causing distress or failure of the concrete and the probable extent of such damage, (b) determine the ability of the concrete to perform satisfactorily under anticipated conditions of future service, and (c) determine selected physical and mechanical properties of the foundation and associated materials as they relate to possible stability analysis of the structure. The District would perform a stability analysis if necessary.

#### Scope

4. This report presents: (a) The drilling effort involved in recovering samples of concrete, foundation rock, and backfill material associated with the project, and (b) the physical condition and extent of damage of in-place concrete using visual, petrographic and physical property information and data. Selected physical properties of core samples were determined using standard Corps of Engineers test methods.

#### PART II: PRELIMINARY STUDY

- 5. A WES geologist made a brief inspection of the lock structure to determine the general condition of the concrete\* in the different elements of the lock and select boring locations. The guide walls, guard walls, and the lock walls were inspected for signs of concrete deterioration with special emphasis on cracking and possible chemical attack and aggregate reaction.
- 6. There was no intent during this initial inspection to provide details of where cracking occurred or specifically locating areas of distress in the structure. If a crack survey and surface mapping were thought necessary, such work was to be proposed. As a result of this preliminary inspection, it was determined that no further documentation of the concrete condition was necessary.
- 7. The lock crew provide a work barge to allow closer observation of the concrete within the lock chamber both at the upper and lower pool elevations. While on the barge, the upper and lower guide walls and the river side of the river lock wall were inspected.

# Esplanade

8. The concrete is generally in good condition with the individual panels intact. Some relative displacement of panels is evident. The surfaces of the panels are similar in appearance to that of the mass concrete with some exposure of coarse limestone aggregate. Fifty percent aggregate exposure is evident in many of the panels.

# Upper Guide Wall

9. The backfill from monolith 15 to monolith 24 is below the top of the guide wall while the backfill from monolith 25 to monolith 29 is above the top of the wall as it is for the rest of the guide wall. It is grassed and shows no signs of any depressions (Figure 1). There are fine-to-medium transverse cracks\* at one-third points between the monolith joints. Surface

<sup>\*</sup> See ref American Concrete Institute Committee 201, 1980, for definition of terms associated with the durability of concrete.

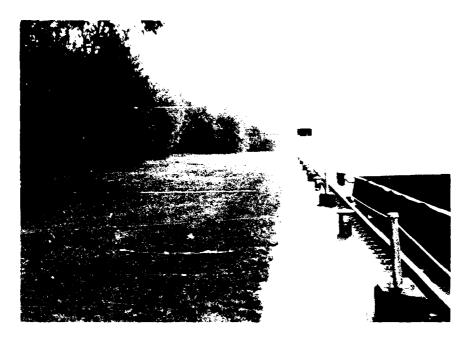


Figure 1. Grassed area behind upper guide wall

deterioration on the top of the wall is limited to exposure of the limestone coarse aggregate with approximately 15 percent of the surface affected.

10. The river face is armored from the service bridge for the emergency dam to the upstream end of the wall. The concrete is intact and only shows light weathering. There is some light scaling along the monolith joints.

### Land Wall

- 11. <u>Horizontal surface</u>. The concrete on this surface is in good condition with approximately 15 percent of the surface displaying signs of aggregate dissolution in which the aggregate appears etched as the paste remains standing in relief. Short fine-to-medium cracks are found associated with structural features such as openings in the concrete and mooring pins.
- 12. River face. The surface is generally in good condition. Below the upper pool elevation there is some minor spalling of the monolith joints. Surface above the upper pool shows 20 percent exposed aggregate and small joint spalls (Figure 2).
- 13. <u>Gate recesses</u>. The upper gate recess has been refaced, and the concrete is in good condition. There is some cracking of the concrete around

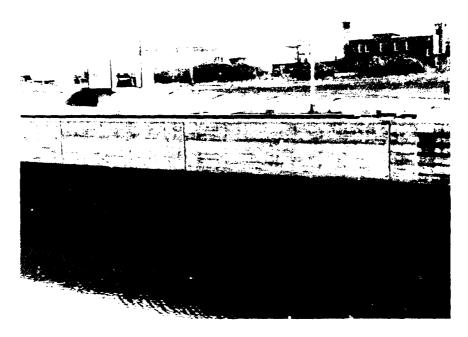


Figure 2. River face of the land wall, large chamber

a recent concrete repair running diagonally from the pintle area near the opening winch recess. The concrete in the lower gate recess is similar to that in the upper gate recess. Some hairline cracks are present on the gate recess face below the gate machinery recess floor line.

### Lower Guide Wall

14. The concrete is uniform along the entire wall. The concrete is in good condition with apparent solution of the crushed limestone coarse aggregate leaving the paste in relief. Some medium-to-fine transverse cracks are present in the monoliths. Alignment of the monoliths is good. Vegetation is growing from the joints on top and on the vertical faces in the settling basin for U.S. Steel Corp.

#### Middle Wall

15. <u>Horizontal surface</u>. The exposure of the limestone coarse aggregate was more pronounced than that of the land wall with an estimated 30 percent of the surface exposed (Figure 3). Popouts on the surface concrete were sometimes numerous (Figure 4) which lends some additional evidence to the possibility of

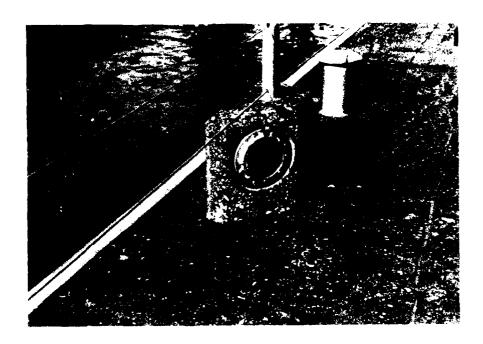


Figure 3. Solution of coarse aggregate particles gives an exposed aggregate appearance to the concrete



Figure 4. Pop-outs caused by nondurable aggregate particles

some low durability aggregate as "D" cracking was observed at monolith joint M-20/M-19 and monolith joint M-22/M-23 as well as around machinery openings in monoliths M-24 and M-25. Cracking of the concrete in monolith M-3 around the lock crane support was evident. Pattern cracking was present in many of the monoliths such as in monoliths 12, 16, and 19. The joint on the river side of monoliths M-24/M-25 was severely cracked with some indicated displacement.

- 16. <u>Land face</u>. The concrete above upper pool elevation is in good condition. The concrete below the upper pool elevation contained approximately 5 percent severely scaled concrete and approximately 30 percent lightly-scaled concrete. Severe spalling was present along the monolith joints (Figure 5).
- 17. Gate recesses, large lock. The upper-gate recess concrete is in good condition with little weathering. The joints are as cast. The concrete in monolith M-5 in the vicinity of the opening winch is severely scaled with efflorescence outlining numerous cracks contained in localized areas. The lower gate recess has some spalling of the concrete with some concrete in the process of falling off. In general, the concrete is in good condition.

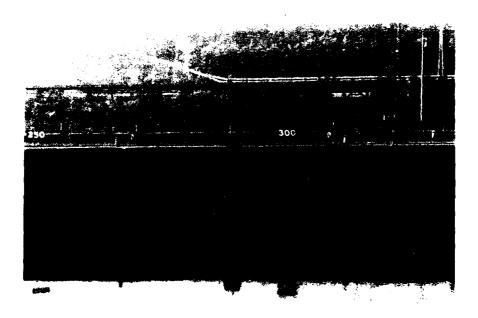


Figure 5. Severe spalling along monolith joints in land face of middle wall

18. River face. The concrete above the upper pool elevation contains some medium scaling affecting 75 percent of the area. Some small spalls are

evident along joints below the upper pool elevation. There is some spalling between upper and lower pool elevations, but generally the concrete is in good condition.

19. <u>Gate recesses</u>, small lock. Some scaling is evident in the concrete especially below the upper pool elevation where 80 percent of the area is affected. Some cracking was observed near the corners of grated openings associated with the gate machinery. Minor spalling was observed.

## River Wall

- 20. <u>Horizontal surface</u>. The concrete has an exposed aggregate appearance with 30 percent of the concrete affected. Seventy percent of the concrete surface is slightly eroded with some popouts. There are many incipient hairline cracks along the edge armor. The corners of the monoliths show signs of "D" cracking, but the surface concrete is generally in good condition.
- 21. <u>Land face</u>. Above the upper pool elevation, the concrete is generally in good condition. Ten percent of the surface has an exposed aggregate appearance. Some iron staining is present. The armor is in good condition and is in intimate contact with the concrete. The joints above the upper pool elevation are as cast while the monolith joints below upper pool elevation are commonly spalled especially in the non-armored areas. Ten percent of the surface is scaled below the upper pool elevation.

#### Upper Guard Wall

22. Cracking is common around the light posts. Exposed aggregate is visible over 30 percent of the surface. Some minor popouts are present, and fine healed hairline cracks parallel the corner armor. The land-wall face is armored from the upper gate recess to monolith No. 1. Exposed aggregate is evident for about the upper 2 ft of concrete and affect approximately 15 percent of the area. The concrete below 2 ft is in good condition.

#### Lower Guard Wall

23. Lower guard wall. The land face is armored from the lower gate to the downstream end of the wall and is in good condition. There is some slight

spalling of the joints generally near the lower pool elevation. About 15 percent of the surface has an exposed aggregate appearance. Efflorescence is present in the upper 1 ft of monoliths R-24 and R-29 through R-31. Cracking of the upper surface is present in monoliths R-29 through R-31. Severe scaling is present in 2 percent of monolith R-30.

#### PART III: DRILLING OPERATION

24. Following the on-site inspection, a drilling plan was formulated to investigate the different qualities of concrete represented in the lock walls, Plate 3. The requirements to obtain foundation samples for purposes of evaluating the foundation condition and conducting physical property tests were considered in locating the concrete borings. The borings were distributed as follows:

	Number of	Core		h, ft	
Location	Borings	Size, in.	<u>Vertical</u>	Horizontal	Remarks
Upper guide wall	1	4	10		Concrete
Land wall	3	6	80		Backfill & rock (omitted one)
Land wall	2	6		3	Concrete
Land wall	2	6	10		Concrete (R-17 Extended)
Lower guide wall	1	6	10		Concrete
Middle wall	2	6	80		Concrete & rock
Middle wall	4	6		3	Concrete
Upper guard wall	1	6	10		Concrete
River wall	1	6	10		Concrete (omitted)
River wall	1	6	80		Concrete & rock
River wall	2	6		3	Concrete
Lower guard wall	1	6		3*	Concrete
Lower guard wall	1	6	10		Concrete

<sup>\*</sup> Inclined.

25. This plan was modified during the drilling program to accommodate unanticipated adverse drilling conditions and logistics in setting up at

several boring locations. One alternate boring was drilled (BR WES L-7A)\* as a 5-in. (i.d.) steel pipe was intersected at approximately 5.4 ft. Two scheduled borings, L-8 into the backfill and foundation rock and R-2 adjacent to the service crane on the river wall, were not drilled because of logistics problems. Proposed boring L-8 was one of 3 borings into the backfill and foundation rock. There were difficulties encountered in drilling backfill borings L-2 and L-5; i.e. slag, silt, mud, sandstone boulders, brick and pieces of steel were frequently encountered in an unconsolidated state. Because it was difficult to drill and obtain samples of such a variety of materials, it was decided that the third boring would not be drilled. However, boring L-7A in the land wall was extended to include the foundation rock representing the downstream portion of the lock.

- 26. The drilling plan consisted of 21 borings with 8 horizontal borings into the lock walls, one inclined boring into the lower guard wall, and 12 vertical borings into the lock and backfill with six of the vertical borings going into foundation rock. Pertinent information concerning the boring number, depth of hole, core size, direction of boring, elevation top of hole, elevation top of rock, and elevation bottom of boring is presented in Table 1. General boring locations are illustrated in Plate 3; detailed locations are illustrated in the field logs, Appendix B.
- 27. WES provided two drill crews for the field operation. Two geologists from WES and one from the Pittsburgh District were present during the drilling. All concrete and foundation material were logged by the field geologists. Photographs were made of all cores soon after the cores were removed from the core barrel (Exhibit 1).
- 28. The drill crews and equipment arrived at Locks and Dam No. 2 on 18 October 1985. The district provided barge and crane support in moving the drill rigs from L/D No. 4 where a drilling program had just been completed.
- 29. Equipment used during this project included: a Failing 1500 truck mounted rig used to drill all the vertical borings on the land wall and into the backfill, an Acker skid rig and a Failing Model 43-6A skid rig used to drill the deep holes in the middle wall and river wall, and a KOR-IT

<sup>\*</sup> Boring designation: BR for the town of Braddock in which the project is located; WES for the drilling agency; L-7A for land wall, number of boring and A for alternate boring. All other references to borings will be done using the wall designation letter and number of the boring.

Series K-100 portable rig used to drill the horizontal holes and vertical borings not accessible using the skid rigs or the truck-mounted rig.

30. The lockmaster provided a work flat for the drill crews to operate equipment while drilling the horizontal borings within the lock chambers. The vertical position of the work flat was positioned by raising and lowering the pool level within the lock chamber. Anchor bolts were placed into the concrete and held the drill to the wall during the drilling operation (Figure 6).



Figure 6.

- 31. The split-spoon samples were collected, placed, and sealed in 6 x 12-in. plastic concrete cylinder molds. The rock cores were wrapped and waxed to protect the core and prevent moisture loss. The cores were then placed in wooden core boxes and readied for shipment to WES. The concrete cores were put into wooden core boxes to prevent damage during transportation. All rock cores, concrete cores, and samples placed in the cylinder molds were shipped to WES for examination and testing.
- 32. Drill Manufacturers Association standard 6 x 7 3/4-in. and 4 x 5-in. double tube swivel tub core barrel was used with diamond Lits to obtain the concrete and bedrock core in vertical borings. A single tube core barrel

with a diamond bit was used to take the horizontal cores and some of the shallow vertical cores.

- 33. Borings into the backfill were filled by allowing the surrounding material to slough when the casing was removed. All holes resulting from concrete borings were filled using a prepackaged concrete. The horizontal holes were filled with a relatively dry mixture while the vertical holes were filled using a more workable mixture of the same material.
- 34. Concrete core recovery was 100 percent for all concrete cores except one. A short interval in boring R-5 at approximately 55-ft depth was ground up during the drilling operation and was removed from the core barrel in fragments. The rock recovery was good for all cores into the foundation with an average recovery of 94 percent. Only 80 percent of the rock in boring L-5 was recovered while recovery in the other borings ranged from 92 to 92 percent.
- 35. Samples of backfill material were taken every 5 feet. The material ranged from loosely consolidated slag particles to zones of clay silt material (Figures 7 and 8). Approximately 115 ft of backfill was drilled and sampled, much of it required casing to prevent sloughing of adjacent material. A total of 328.8 ft of concrete core and 185.95 ft of foundation rock was cored.
- 36. The drilling program was completed 18 February 1986. During this field operation several days were lost due to subfreezing temperatures in which the wind chill factor went as low as -40°F. Other delays included two work stoppages due to flooding of the lock structure (Figure 9), once from 27 November through 29 November 1985 and once from 5 February through 7 February 1986.



Figure 7.

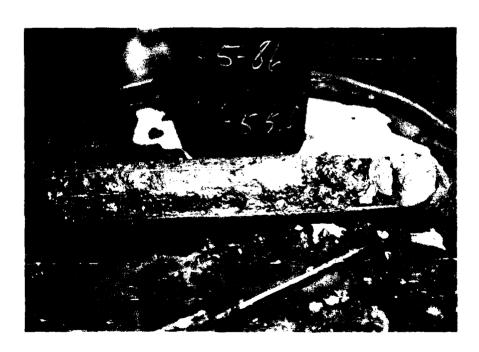


Figure 8.

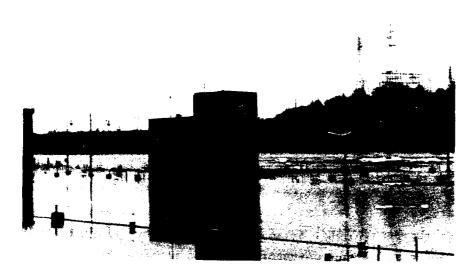


Figure 9.

#### PART IV: GEOLOGY

- 37. The lock site geology is taken from the Periodic Inspection and Continuing Evaluation of Completed Civil Works and Structures "Monongahela Lock and Dam No. 2, Monongahela River, Pennsylvania First Periodic Inspection Report, 28 August 1973."
- 38. The basin of the Monongahela River is located in the Allegheny Plateau province and is carved out of gently folded shales, sandstones, thin limestones, and coals of the Carboniferous system. The basin is essentially a dissected plateau in which are developed in varying degrees the Schooly, Harrisburg and Worthington peneplains. The land slopes are steep except on a few terraces and relatively narrow flood plains within the main valley. The bedrock encountered in the borings belong to the middle members of the Conemaugh formation of the Pennsylvania series. Underlying the alluvial fill are the basal few feet of the Upper Pittsburgh redbeds member, the thin Jane Lew sandstone, not over 3 ft thick, the Lower Pittsburgh redbeds member, a siltstone, about 40 ft thick, and the extremely fossiliferous Wood Run limestone member.
- 39. Six borings were made into the foundation rock during the current project. Four borings were made through concrete walls, and two borings were made through the backfill behind the land wall. The deepest rock boring was L-7A taken to elevation 611 ft. The other cores were taken to obtain approximately 20 ft of rock core from each boring and were generally to elevations near 640 ft.
- 40. The backfill material consisted of a variety of different materials, most of which were clay, silt and pea-size gravel. Also included were flakes of steel, pieces of brick, particles of slag, large size sandstone pieces, and chunks of steel. These materials were common to both backfill holes. The foundation rock began at elevation 667.3 ft in boring L-2 and at elevation 675.6 ft in boring L-5. Boring L-2 consisted of shale to elevation 658.5 ft where the rock became more silty to the end of the boring at elevation 646.5 ft. Boring L-5 consisted of clay shale, fractured shale, and brown shale to the end of the boring at elevation 657.3 ft. Some soft-clay shale was present in both holes at the backfill to foundation rock contact.
- 41. Boring L-7A was the only boring drilled in the land wall, and it went into foundation rock. The concrete to foundation interface was intact at elevation 671.6 ft (56.9-ft depth). Foundation rock consisted of clay shale

rubble, silty shale, and clay shale with slickensides evident on break surfaces. The boring went to elevation 611 ft.

- 42. Foundation cores were taken at the upper and lower end in the middle wall. Two borings, M-l and M-6, through the middle wall and into the foundation rock intersected the foundation at elevations 672.15 ft and 667.1 ft. The concrete to rock contact was not intact. Boring M-l consisted of a mixture of soft to moderately hard clay shale, red shale, gray shales, and brown clay shale while the rock in boring M-6 was generally a gray moderately hard silty shale with numerous healed fractures.
- 43. Boring R-5 was the only hole drilled in the river wall that intersected the foundation rock. The concrete foundation interface at elevation 663 ft was not intact as the rock fragments were in contact with the concrete. The rock was generally intact and consisted of a moderately hard sandy shale with calcareous inclusions.
- 44. Previous boring data indicate the foundation rocks in this area consist of indurated clays, silty clay shale, moderately hard gray clayey siltstone, and medium hard to hard gray siltstone. The current description of the foundation cores parallels the descriptions of the rocks previously cored as described in the First Periodic Inspection Report.

#### PART V: TEST SPECIMENS AND TEST PROCEDURES

### Cores Received

- 45. Approximately 630 ft of core was received at the WES from 21 total borings. Twelve of these b rings were vertical, ranging in depth from 1.7-ft to 119-ft, for a total of 601 ft. There were 8 horizontal borings, all of approximately 3-ft depth, totaling 25 ft of core. One inclined boring was made to a depth of 3 ft.
- 46. Core boxes were stored in a local warehouse near the project site for protection from the weather until the job was completed, and they were shipped to WES. All the cores were received in good condition, and no sample damage due to rough handling was detected. Once the cores arrived at the WES, they were stored inside to minimize effects of exposure to normal weathering.
- 47. In addition to concrete and rock cores, samples in 8 plastic bags and 24 plastic cylinders were received. These samples consisted of material recovered from the backfill area of the land wall in two holes and rubble material from bedrock in one hole. These samples were sealed to prevent loss of moisture and were also received undamaged. Pertinent information concerning the concrete and rock samples as received is presented in Table 1.

#### Selection of Test Specimens

- 48. A visual examination of all cores received was made in the laboratory to supplement the field boring logs and to assist in the selection of representative test specimens. Concrete specimens were selected for testing based upon location, depth, and physical condition. Representative properties throughout the structure could thus be obtained.
- 49. A total of 20 concrete specimens were selected for physical and mechanical property testing (see Table 2). These specimens represented concrete from 4 deep (35 ft +) vertical borings; representing each wall, 2 shallow vertical borings (10 to 20 ft), and 9 horizontal borings. These specimens represent all areas of each wall, including both damaged and sound concrete.
- 50. Nine concrete specimens were selected for petrographic examination. These specimens were selected from cores that represented the different

concrete types identified when logging in the cores. They also represented concrete from each area of each of the three lock walls.

- 51. Rock core specimens for both physical testing and petrographic examination were selected as best was possible from areas in close proximity to the base of the structure. All test specimens for direct shear testing were obtained within 8 ft of the concrete foundation contact; a fourth of the specimens were from within 3 ft of the contact. Each of two identifiable rock types were tested according to the availability of samples. Location of rock test specimens is indicated in the appropriate tables of test results.
- 52. The direct shear test specimens ranged in color and had different hardnesses. The majority of the specimens were gray shale with only 1 blue gray and three brown shales. The rock texture was similar throughout. The most noticeable difference between the specimens was hardness. Specimens were put into two groups based on whether they were soft to moderate hard or moderate hard regardless of other features such as color. None of the shale recovered contained detectable weak zones such as clay seams. Without the presence of naturally occurring potentially weak zones, selection of intact test specimens was made. Direct shear tests were conducted along horizontal bedding planes.
- 53. Two borings put into the backfill revealed that a predominance of waste products were placed as fill. Slag, silt, bricks, irregular pieces of steel, and sandstone boulder mixed with water made core recovery extremely difficult. Sandy clayey mud along with, and sometimes mixed with sand and gravel was recovered. Representative samples of the backfill were taken to the soils testing facility and in consultation with a soil specialist, it was decided not to attempt any soils testing. There was no structure left to the samples; and a repeated direct shear test was ruled out due to the mixed nature of the samples plus there was not any reasonable way to arrive at a moisture content and density which is required for reconstituting a repeated direct shear sample. It is thought that experience and engineering judgement available at the District could be used to approximate appropriate backfill properties for stability calculations.

# Laboratory Test Program

#### Concrete cores

- 54. The testing program for the concrete cores consisted of the following:
  - a. Petrographic examination.
  - b. Unit weight, γ.
  - $\underline{c}$ . Velocity,  $V_{\underline{p}}$ .
  - d. Compressive strength.
  - e. Elastic modulus, E.
  - f. Poisson's ratio, v

#### Rock cores

- 55. The testing of the bedrock cores consisted of the following tests. The tests are grouped under either characterization tests or engineering design tests.
  - a. Characterization tests.
    - (1) Effective (as-received) unit weight,  $\gamma_{\rm m}.$
    - (2) Water content, w.
  - b. Engineering design tests.
    - (1) Direct shear strength, intact (peak and residual).

#### Test Procedures

#### Petrographic examination

- 56. The petrographic examination was performed using general guidance from "Standard Recommended Practice for Petrographic Examination of Hardened Concrete," CRD-C 57-78, ASTM C 856-77 (USAE WES, 1949). Concrete from locations where deterioration existed was examined and compared to concrete from locations where nondeteriorated concrete was recovered. This comparison provided information on types of deterioration mechanisms that acted upon the concrete and gave indication of the depth of deterioration.
- 57. The petrographic examination of the rock and river sediment was performed using general guidance from "Standard Practice for Petrographic Examination of Aggregates for Concrete," CRD-C 127-80 ASTM-C 295-79 (USAE WES, 1949). The river sediments were also examined visually and classified using

the "Soil Classification Chart" in "Standard Test Method for Classification of Soils for Engineering Purposes," ASTM-D 2487-69 (Reapproved 1975). Unit weight  $(\gamma)$ 

58. The unit weight of the concrete was determined according to "Standard Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete," CRD-C 23-84 ASTM-C 642-82 (USAE WES, 1949). The apparent specific gravity was determined for each selected test specimen. The specimens were weighed in water and in air. The unit weights were then calculated by multiplying the apparent specific gravities by 62.43 lb/ft<sup>3</sup>.

# Pulse velocity (V<sub>p</sub>)

59. The pulse velocity was determined for the concrete according to "Standard Method of Test for Pulse Velocity Through Concrete," CRD-C 51-70 ASTM-C 597-71 (USAE WES, 1949).

# Compressive strength, elastic modulus (E), and Poisson's ratio ( $\nu$ )

- 60. The compressive strength, elastic modulus, and Poisson's ratio were determined according to "Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression," CRD-C 19-83 ASTM-C 469-81 (USAE WES, 1949). Strain gages, 2 vertical and 2 horizontal, were bonded to the specimens for purposes of measuring the axial and diametrical strains. The electrical impulses were averaged for the two orientations of strain gages to minimize the affects of core imperfections. Strength corrections were made for specimens with L/D ratios less than 1.8.
- 61. The characterization properties tests and the engineering design properties tests of the foundation rock were conducted in accordance with the appropriate test method tabulated below:

		Test Method		
Property	<del></del>	Rock	Concrete	
Characterization				
Effective Unit Weight (As-Received),	Υ <sub>m</sub>	RTM 109-80		
Water Content, w	***	RTM 106-80		
Engineering Design				
Direct Shear Strength		RTM 203-80		

#### PART VI: TEST RESULTS AND DISCUSSION

### Petrographic Examination

- 62. All of the concrete examined was air entrained. The concrete consisted of two distinct mixtures one using natural river gravel for coarse aggregate and another mixture using a crushed carbonate coarse aggregate. Both concrete mixtures used a natural fine aggregate. The concrete examined in the current program is as reported in the information provided in the First Periodic Inspection of Lock and Dam No. 2. Concrete above elevation 691.75 ft consisted of a 3-in. top size crushed gravel as the principal mixture.
- 63. The concrete was generally in good condition and intact with little or no evidence of internal cracking. Concrete from the various parts of the structure was generally hard, dense and well consolidated. A summary of the cores examined are presented in Plates 4 thru 20. Details of the petrographic examination of the concrete are presented in composite field and laboratory logging of the cores in Appendix B and in the petrographic examination of the concrete cores as presented in Appendix C.
- 64. The surface of the concrete was eroded in some areas while in other areas the surface remained intact. Some of the surface concrete appeared to have been attacked chemically as the surfaces appeared etched with the siliceous aggregate remaining in relief and the carbonate coarse aggregate etched away leaving slight depressions in the concrete. Some popouts were present in the concrete. The extent of any damage to the concrete seemed to be limited to the near surface region. The following sections summarize the concrete from the different locations of the lock structure.

#### Concrete Quality

# Guide walls

- 65. The preliminary study indicated that the surface concrete was limited to some dissolutioning of the surface and exposure of the coarse aggregate. Some spalling was present along the monolith joints.
- 66. Two vertical borings were drilled in the guide walls, one in the upper guide wall and one in the lower guide wall. Only slight weathering of the surface concrete was observed in the cores. The concrete in these cores

contained 3-in. maximum size crushed limestone aggregate. The strength of the concrete was over 5,000 psi.

- 67. The boring drilled into the lower guide wall also showed surface weathering with some light scaling. The near surface concrete was 0.5-in. maximum size crushed limestone coarse aggregate to 1.5-ft depth where the concrete has 3-in. maximum size crushed limestone coarse aggregate. The boring was taken along a crack. The crack extends approximately 3 ft into the concrete. No chemical nor alkali-aggregate reaction was found associated with the crack.
- 68. The tabulation below summarizes the depth of damaged concrete for borings into the guide walls.

		Boring Di	irection	Damaged Concrete
Structural Element	Boring	Horizontal	Vertical	Depth, ft
Upper guide wall	L-1		X	none
Lower guide wall	L-9		X	none

#### Guard walls

- 69. Fine healed hairline cracks were common in the surface concrete of the guard walls. The concrete was slightly eroded with an exposed aggregate appearance. Some efflorescence and scaling were also present in some monoliths.
- 70. Three borings were drilled into the guard walls, two vertical borings and one inclined boring. Boring R-1 drilled into the upper guard wall consisted of a mixture of crushed and natural gravel coarse aggregate. The surface of the core was intact and showed no signs of deterioration.
- 71. Boring R-7 was a vertical boring drilled into the lower guard wall. The surface concrete was in good condition. Compressive strength of a test specimen taken from near the top of the boring was 4,480 psi. The inclined boring taken from the river side of the lower guard wall indicated some medium to severe scaling of the concrete at the surface. The interior concrete was in good condition.
- 72. The tabulation below summarizes the depth of damaged concrete for borings into the guard walls.

		Boring Di	lrection	Damaged Concrete	
Structural Element	Boring	Horizontal	Vertical	Depth, ft	
Upper guard wall	R-1		X	none	
Lower guard wall	R-6	inclined		none	
Lower guard wall	R-7		X	none	

#### Land wall

- 73. Top surfaces of the land wall showed signs of aggregate dissolutioning. Fine cracks were present around structural features such as openings and mooring pins.
- 74. All three vertical borings into the top surface of the land wall showed only surface deterioration of the concrete with the surfaces showing light and medium scaling. The concrete was generally dense with good consolidation and contained crushed limestone coarse aggregate.
- 75. The compressive strength of the near surface concrete in boring L-1 was 5,990 psi. The test of interior concrete from boring L-7A indicated concrete with compressive strength of 5,790 psi.
- 76. Two horizontal cores were taken from the river face of the land wall, one near the upper pool level at elevation 726.5 ft (L-4) and one near lower pool level at elevation 715.5 ft (L-6). Both cores showed moderate surface weathering with some exposed aggregate at the surface. The concrete cores from both borings consisted of air-entrained concrete composed of crushed limestone coarse aggregate. Only surface damage was evident in the cores. The compressive strength of the cores were 6,770 psi for near surface concrete from boring L-4 and 4,460 psi for interior concrete at a 2-ft depth from the beginning of boring L-6.
- 77. The tabulation below summarizes the depth of damaged concrete for borings into the land wall:

		Boring Di	rection	Damaged Concrete	
Structural Element	Boring	Horizontal	Vertical	Depth, ft	
Land wall	L-3		X	none	
Esplanade/Backfill	L-5		X	none	
Land wall	L-4	X		none	
Land wall	L-6	X		none	

(Continued)

		Boring Di	rection	Damaged Concrete
Structural Element	Boring	Horizontal	Vertical	Depth, ft
Land wall	L-7		X	none
Land wall	L-7A		X	none

#### Middle wall

- 78. Appearance of the concrete in the middle wall was similar to that in the land wall. Additionally, the concrete in the middle wall contained numerous popouts at times and also had some "D" cracking along some monolith joints indicating that some low durability aggregate was used in the concrete.
- 79. Two vertical borings were drilled into the top surface of the middle wall. Borings M-l and M-6 consisted of concrete with a l-in. maximum size aggregate to one foot depth. The remainder of the concrete for both holes to the full depth of the concrete contained 3-in. maximum size coarse aggregate. Only slight surface deterioration was present in the cores recovered from this lock wall.
- 80. Tests of near surface concrete and interior concrete indicated the concrete to have compressive strengths of over 6,000 psi. The near surface concrete with the smaller aggregate had strengths of 7,130 psi and 7,840 psi. The interior concrete had strengths of 6,480 psi, 6,950 psi, and 7,810 psi.
- 81. Concrete from the land face of the middle wall was similar to the concrete from the river face of the middle wall as described in the Preliminary Study section of this report. Scaling of the surface was the most common deficiency. Borings M-2 and M-5 were drilled into the land face with M-2 near the lower pool elevation at 717.1 ft and M-5 near the upper pool elevation at 723.9 ft. The surfaces appeared to have been eroded due to abrasion and dissolutioning. Cracking of the concrete at 0.1 ft below the surface in boring M-2 indicated depth of deteriorated concrete was more than only surficial.
- 82. Two borings made into the river face of the middle wall were made at elevations 716.3 ft and 725.3 ft for borings M-3 and M-4, respectively. Both cores consisted of air-entrained concrete composed of 4-in. maximum size coarse aggregate. Only surface deterioration of the concrete in the form of scaling was observed.
- 83. Compressive strengths determined for the concrete in both land and river faces of the middle wall were above 6,000 psi.

84. The tabulation below summarizes the depth of damaged concrete for borings into the middle wall:

		Boring Direction		Damaged Concrete
Structural Element	Boring	Horizontal	Vertical	Depth, ft
Middle wall	M-1		X	none
Middle wall	M-2	X		none
Middle wall	M-3	X		0.1
Middle wall	M-4	X		none
Middle wall	M-5	X		none
Middle wall	M-6		X	none

#### River wall

- 85. Light scaling was the major deficiency in the concrete from the river wall. The concrete was represented by one vertical boring the full depth of the concrete, boring R-5, and two borings into the land face drilled in the small lock chamber. Those borings were at elevations 725.3 ft and 715.0 ft for borings R-3 and R-4, respectively.
- 86. Concrete from boring R-5 contained 2.5-in. maximum size natural coarse aggregate throughout the length of the core which was unlike the other vertical cores taken in the other walls in which the upper foot consisted of concrete made using a smaller coarse aggregate. The concrete was intact, air entrained, and in good condition. Strengths determined for the concrete were 5,890 psi for the near surface concrete and 6,400 psi and 4,500 psi for interior concrete.
- 87. Boring R-3 was drilled near a monolith joint and a lift joint. The boring intersected some reinforcing steel at approximately 0.8-ft depth. The steel was in good condition. The surface concrete was slightly weathered with some medium scaling. Interior concrete was intact, contained 3-in. maximum size natural coarse aggregate, and was air entrained.
- 88. Boring R-4, representing concrete at the lower pool elevation, was slightly more eroded and weathered than the concrete in the upper pool elevation. Towever, the interior concrete was similar to the upper pool elevation concrete consisting of intact air-entrained concrete with 3-in. maximum size natural coarse aggregate. The concrete strengths determined for the upper and lower pool elevation concrete were 6,830 psi and 6,550 psi, respectively.

89. The tabulation below summarizes the depth of damaged concrete for borings into the river wall:

Structural Element		Boring Direction		Damaged Concrete
	Boring	Horizontal	Vertical	Depth, ft
River wall	R-3	X		none
River wall	R-4	X		none
River wall	R-5		Х	none

- 90. The physical properties of the concrete are tabulated in Table 3. The unit weight of the concrete ranged from a low of  $142.4 \text{ lb/ft}^3$  to  $151.9 \text{ lb/ft}^3$ . The average was  $147.0 \text{ lb/ft}^3$ .
- 91. The pulse velocity of the concrete ranged from 13,486 ft/sec to 16,652 ft/sec. The average pulse velocity for this concrete was 15,125 ft/sec. Lower pulse velocities of 13,486 ft/sec, 13,801 ft/sec, and 13,912 ft/sec correlated with concrete having strengths of 4,480 psi, 4,500 psi, and 5,790 psi, respectively, which were some of the lower strength concrete measured. Two cores, one from boring L-1 and on from L-4 had strengths of 5,360 psi and 4,460 psi, respectively, which had pulse velocities above 16,000 ft/sec.
- 92. The compressive strength of the concrete was generally over 5,500 psi with only 3 of the 20 specimens tested below this figure. All strengths were above 4,500 psi with the average compressive strength for both interior concrete and exterior concrete at 6,190 psi. There was no significant difference between strengths of concrete from near the surface and concrete in the interior of the structure.
- 93. The principal concrete mixtures used in the construction of the lock walls were a 4-bag mixture using 3-in. nominal maximum size crushed gravel and a 5-bag mixture using 1 1/2-in. top size crushed gravel. The 28-day compressive strengths for the mixtures were 4,314 psi and 5,637 psi, respectively. The average strength of the concrete is above the 28-day strengths reported for the mixtures used in the lock wall construction.
- 94. The data for the Poisson's ratio and modulus of elasticity are presented in Table 3. The stress-strain curves are presented in Plates 33 to 38. Average Poisson's ratio for the concrete tested was 0.24 for the

specimens tested. Poisson's ratio ranged from 0.16 to 0.29. The average modulus of elasticity was  $4.0 \times 10^6$  psi.

#### Peak and Residual Shear Strength

- 95. A limited number of intact shale specimens were tested for shear strength parameters. A summary of the direct shear test results, density, and water content of foundation core is presented in Table 4. The rock core was divided into two groups based upon hardness. A moderately hard shale, and a soft to moderately hard shale were identified.
- 96. The shear stress versus shear deformation and the normal versus shear deformation curves are presented in Plates 21 thru 34. Shear stress versus normal stress plots were drawn up for the two groups of rocks. The shear strengths obtained from the soft to moderate hard rocks plotted reasonable well considering the scatter in shear strength at a given normal load; an angle of internal friction for peak strengths ( $\emptyset$ p) and cohesion (C) was calculated and is 51.9° and 5.4 psi respectively. The residual shear angle ( $\emptyset$ r) for the soft to moderate hard rocks was calculated and is 25.0° with a C = 2.1 psi. Shear strength parameters were calculated by the method of linear regression.
- 97. When the peak shear strengths obtained from the moderately hard rocks were potted, there was a wide scatter in the shear strengths for a given normal load. This indicates a variation between specimens which is probably due to differences in hardness between specimens within this group. The residual shear strength values plotted much closer together than did the peak shear strengths indicating relative consistency in this lower bound strength parameter.
- 98. After studying the similarity in the shape of the shear stress versus shear deformation curves, the specimen densities and moisture contents, and the peak and residual shear strengths, it was decided to plot all the shear test results together, and calculate a peak and residual failure envelope for all specimens. It was thought that the foundation rock within 8 ft of the concrete-foundation interface would be better represented by doing this. In making the calculation of shear strength parameters for both groups of rocks, a few data points were thrown out because they were widely scattered from the majority of the other data points. In other words the few data

points were thrown out because they were believed to belong to another rock population.

99. The stress stress versus normal stress plot for the two groups or rocks is presented in Figure 10. The peak shear strength parameters are, for the angle of internal friction ( $\emptyset$ p) and cohesion (C), 47.5° and 6.4 psi respectively. The residual shear strength parameters are 25.8° and 1.32 psi respectively for  $\emptyset$ p and C. These shear strength values are thought to be representative of the foundation rock in close proximity to the founding elevation of the lock walls.

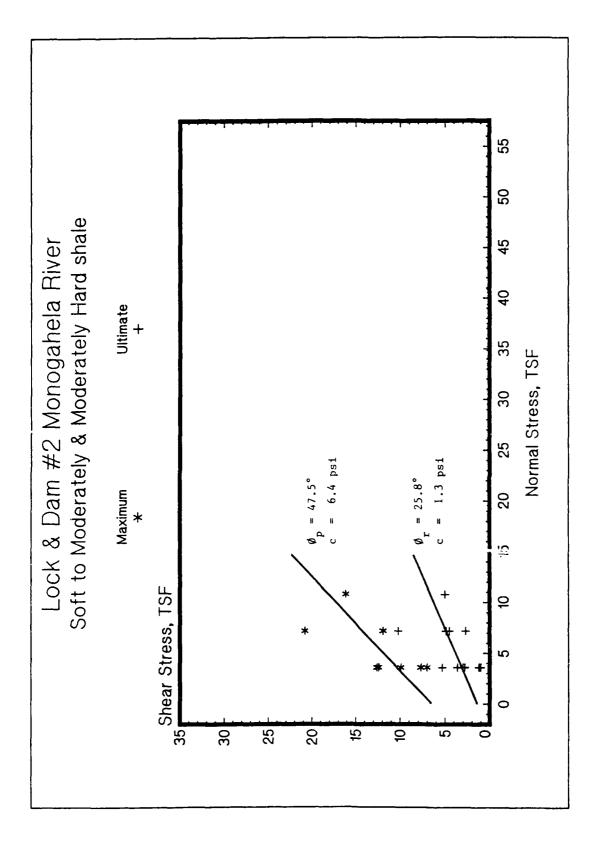


Figure 10. Failure envelopes for foundation rock

## PART VII: CONCLUSIONS AND SUMMARY

- 100. The concrete at Locks and Dam No. 2 making up the lock walls, the guide walls, and guard walls is in fair to good condition. All of the concrete is air entrained which has protected the concrete from any major freezethaw damage. Some surface scaling is evident in most of the concrete, but the original surface is generally recognizable.
- 101. Dissolutioning of the limestone coarse aggregate is evident throughout the entire lock structure. The aggregate is partially dissolved thus weakening the support of the thin surface mortar which has eventually eroded away causing the concrete to have an exposed aggregate appearance. The phenomenon is widespread but is confined to the surface of the concrete and has not caused any deep penetrating damage to the concrete.
- 102. During the construction of the lock, the majority of the concrete was a 4-bag mixture using 3-in. maximum size coarse aggregate and then topped with a 5-bag mixture using 1 1/2-in. maximum size coarse aggregate. Both concretes were found to be in good condition, and interface between the two concretes was generally intact.
- 103. The steel armor has protected the guide walls, the guard walls, and the lock walls from abrasion due to the river traffic. The concrete associated with the armoring is in good condition.
- 104. Some "D" cracking was present along the monolith joints, but the cracks appeared healed. Hairline cracks were also common along the steel-edged plates along the river wall and the guard walls. These hairline cracks do not appear to be active.
- 105. Popouts are common on some of the surfaces. This indicate that some of the aggregate used in the construction was low-durability aggregate. Popouts are surface features and will not affect the internal integrity of the concrete.
- 106. Vertical cracking was present on the top of the guide walls at periodic intervals and was not associated with any apparent chemical reaction and did not appear to be active. The cracks may have been due to original shrinkage of the concrete.
- 107. Some vertical monolith joints have spalled. Borings made adjacent to these areas have indicated that the depth of deterioration is confined to

the visible spalled concrete. No damage due to the interior cracking was evident in the cores examined from these areas.

- 108. Some minor repairs have been made in the gate machinery area. The repaired concrete is generally in good condition. Some cracking of the concrete was noted in the vicinity of some of the operating winches. The concrete from borings adjacent to these areas indicates that the concrete is intact and in good condition.
- 109. The near surface concrete shows only minor surface deficiency. While at the present these surface defects are not currently a maintenance problem, as normal weathering progresses, the concrete surface will continue to deteriorate as it has in the past, which is essentially none at all. Vertical and horizontal core showed no signs of deterioration, and the exterior concrete has not deteriorated since construction.
- 110. The shale recovered from the lock wall foundation did not contain weak zones such as clay seams, therefore, intact specimens were tested in direct shear parallel to bedding. Two groups of shale were identified and tested separately. For the analysis of the direct shear strength parameters, the groups were combined due to similarities in the shear stress versus shear deformation curves and similarity of other key rock properties. The peak shear strength parameters are  $\emptyset p = 47.5^{\circ}$  and C = 6.4 psi. The residual strength values are  $\emptyset r = 25.8^{\circ}$  and C = 1.32 psi.

## PART VIII: PROJECTED CONCRETE CONDITION

- 111. No major deteriorating mechanism was recognized in the laboratory investigation that was likely to degrade the concrete at the locks during the next 50 years.
- 112. The concrete surfaces, both vertical and horizontal, showed no sign of deterioration beyond normal weathering since construction, therefore a rate of deterioration was not calculated for Locks and Dam No. 2. Some cracking of the horizontal and vertical concrete surfaces was evident, however. These cracks, along with possible cracks in the galleries and the emptying and filling culverts, should be mapped for future reference. The concrete should remain in serviceable condition for a period extending on the order of 50 years from the date of this investigation.

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Table l
Pertinent Boring Information

Boring No. BR WES	Depth of Hole, ft	Core Size, in.	Direction of Boring	Elev Top of Boring, ft	Elev Top of Rock, ft	Elev Bottom of Boring, ft
L-1	10.55	6	v	730.5		719.95
L-2	80.5	4	V	727.5	667.8	647.0
L-3	16.1	6	v	732.5		716.4
L-4	3.2	6	Н	715.5		
L-5	73.2	6	V	730.5	675.6	657.3
L-6	2.55	6	Н	726.5		
L-7	6.5	6	V	730.5		724.0
L-7A	119.5	6	V	730.5	671.6	611.0
L-9	10.65	6	v	730.5		719.85
M-1	97.1	6	v	732.5	672.2	635.4
M-2	3.2	6	н	717.1		
M-3	3.2	6	Н	716.3		
M-4	2.9	6	Н	725.3		
M-5	3.3	6	Н	723.9		
M-6	91.7	6	V	732.5	667.1	640.8
R-1	1.6	6	v	730.5		728.9
R-3	3.1	6	Н	725.3		
R-4	3.1	6	н	715.0		~
R-5	90.7	6	v	730.5	663.0	639.8
R-6	3.3	6	I	715.5		
R-7	3.0	6	v	730.5		727.5

Table 2

Core Received at WES from Locks and Dam No. 2, Monongahela River

Structures Lab			Core		
I.D.	Field I.D.	Location	Dia, in.	Material	Boxes
Pitts-13 CON-1	BR WES L-1	U.S. End of	6	Concrete	4
to CON-4		Guide Wall	_		
Pitts-13 DC-1,	BR WES L-2	U.S. Land Wall	5,2 1/2	Backfill	18
to DC-18		Backfill	4	& Rock	
Pitts-13 CON-5	BR WES L-3	U.S. Land Wall	6	Concrete	5
to CON-9		Gate Recess			
Pitts-13 CON-10	BR WES L-4	Land Wall	6	Concrete	1
		Lower Pool			
Pitts-13 CON-11	BR WES L-5	Land Wall	6	Concrete	1
DC-19 to DC-33		Esplanade	2 1/2	Backfill	5,12*
Pitts-13 CON-12	BR WES L-6	Land Wall	6	Concrete	1
		Upper Pool			
Pitts-13 CON-13	BR WES L-7	D.S. Land Wall	6	Concrete	3
to CON-15					
Pitts-13 CON-16	BR WES L-7A	D.S. Land Wall	6	Concrete	20
to CON-35					
DC-34 to DC-53				Rock	40
Pitts-13 CON-36	BR WES L-9	D.S. Guide Wall	6	Concrete	4
to CON-39	DR 1120 12 )	<i>5</i> ,5, 3020	Ū	0002000	,
Pitts-13 CON-40	BR WES M-1	U.S. River Wall	6	Concrete	20
to CON-59	DK "ED 11 1	Gate Recess	Ü	concrete	20
DC-54 to DC-65		Gate Recess	6	Rock	12
Pitts-13 CON-60	BR WES M-2	U.S. Middle Wall	6	Concrete	1
11113 13 001 00	DR WED II Z	Land Face	v	oonerete	•
Pitts-13 CON-61	BR WES M-3	Middle Wall	6	Concrete	1
TILLS-13 CON-01	C-II 63W MG	River Face	Ü	Concrete	1
Pitts-13 CON-62	BR WES M-4	Middle Wall	6	Concrete	1
111tts-13 CON-02	DK WES H-4	River Face	U	Concrete	1
Pitts-13 CON-63	BR WES M-5	D.S. Middle Wall	6	Concrete	1
F188-13 CON-03	C-M Caw Md		0	Concrete	1
D4++- 12 CON 6/	DD UEC W 6	Land Face		C	2.2
Pitts-13 CON-64	BR WES M-6	D.S. Middle Wall	6	Concrete	23
to CON-86				ъ.	10
DC-66 to DC-75	DD 1150 D 1		6	Rock	10
Pitts-13 CON-110	BR WES R-1	U.S. Guard Wall	6	Concrete	1
Pitts-13 CON-111	BR WES R-3	U.S. River Wall	6	Concrete	1
		Land Face	_		
Pitts-13 CON-112	BR WES R-4	River Wall	6	Concrete	1
		Land Face			
Pitts-13 CON-87	BR WES R-5	D.S. River Face	6	Concrete	23
to CON-109		Gate Recess	•		
DC-76 to DC-84			6	Rock	9
Pitts-13 CON-114	BR WES R-7	D.S. Guard Wall	6	Concrete	1

<sup>\*</sup> Plastic cylinders.

Table 3

Concrete and Rock Core Test Results Locks and Dam No. 2, Monongahela River

boring No.	Direction of Boring	core Depth, ft	Dia., in.	Length, in.	Unit Weight, pcf	Pulse Velocity, fps	Comp Strength, psi	Elastic Modulus x 10 psi	Poisson's Ratio
							•		
	Λ	0.00- 3.15	5.94	12.25	150.7	16,366	5,360	4.9	0.21
	Λ	0.00- 3.75	- •	12.35	151.9	16,129	5,990		
	Н	0.00- 3.15	5.90	12.40	150.6	16,652	4,460		
	Н	0.00- 2.55	-,	12.50	149.0	15,755	6,770		
	Λ	39.50-43.10	٠,	12.25	146.4	13,912	5,790	3.0	0.16
	^	0.00- 2.30	5.95	12.40	149.0	15,349	7,840		
	Λ	32.60-35.75	~ '	12.25	147.4	14,875	6,480	4.2	0.26
		0.00 - 3.15		12.25	145.2	14,925	6,020	4.4	0.29
	н	0.00- 2.95		12.35	147.8	15,487	6,440		
		0.00- 3.30		12.30	146.7	15,282	6,560		
		0.00- 2.30		11.80	145.6	15,105	7,130		
		26.20-28.90		12.25	145.2	14,705	6,950		
		61.10-63.30		12.30	145.1	14,309	7,810		
	Λ	0.00- 1.65	5.83	12.25	143.5	13,486	4,480	2.9	0.25
		0.00 - 3.10		12.35	148.3	15,487	6,830		
R-4	Н	0.00 - 3.10		12.25	147.5	15,994	6,550	4.5	0.24
	>	16.10-19.20		12.35	144.1	14,492	5,890		
	Λ	35.00-	5.90	12.40	146.7	15,755	6,400		
	Λ	60.40-63.40	5.95	12.35	142.4	13,801	4,500		
	1	0.00- 3.30	5.88	12.40	146.1	14,925	5,520		
				ı×	147.0	15,125	6,190	4.0	0.24
				SD	2.5	875	980	8.0	0.05
				u	20	20	20	9	9

Table 4
Lock and Dam No. 2, Mon River
Summary Direct-Shear Test Results

						Maximum	Restanal	
				Water	Norma1	Shear	Choor	
	Boring No.	Depth	Density	Contant	200	מיובמו	realle	
Hardness	BR WES	, <u>,</u>	(242:00	30116	SSATIO	orress	Stress	
			pcr	9	tst	tsf	tsf	Color
Soft to Mod	r-2	63.9-64.2	166.1	!		,		
Hard	M-1	7 07 7 09	1 1		0,0	/•/	3.0	Brown
3	7 ;	00.4-00.0	7.997	7.0	7.2	9.44	10.2	Cross
	-W N	64.1-64.5	166,1	1.7	10.8	16.1	1 0	61ay
	M-1	8.5-64.8	166.7	, o	,	1.01	0.0	Gray
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	1 - 1	02.2-65./	166.7	1.9	3.6	7.0	3	(
	M-1	65.7-66.0	166.7	1.7	7 2	0 00		oray o
	1 - 7 A	0 77 6 29	100		7.	0.02	4.7	Gray
	4	0.00-1.00	1001	7.4	3.6	6.6	1.0	Grav
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Moderately								
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	ĭ-₩	69.2-69.4	163.6	3,5	7 2	0	, r	ביים הומ
	χ 1-1	71 1 71 5	166 7	,	7.	11.3	7.7	Brown
	;;	C.1/-1.1/	1.001	7.4	3.6	17.3	1.2	Rroam
	M-6	66.9-67.3	166.1	2.3	3.6	79.5	i 0	DE CWIL
	9-W	74.9-75.1	167.3		3 %		0,4	Gray o
	R-5	67 7-68 0	166 1		2 4	0.13	<b>4</b> .0	Gray
	) L	0.50-1.00	1.001	ν.	7.2	24.0	4.5	Grav
	K-5	0.69-9.89	167.9	1.5	10.8	8.44	16.5	Gray
Mean			166 6	} .		•	•	Gray
40			102.3	7.9				
standard Deviation	드		2.5	9.0				
Number of Specimens	ns		17.0	12.0				
				2				

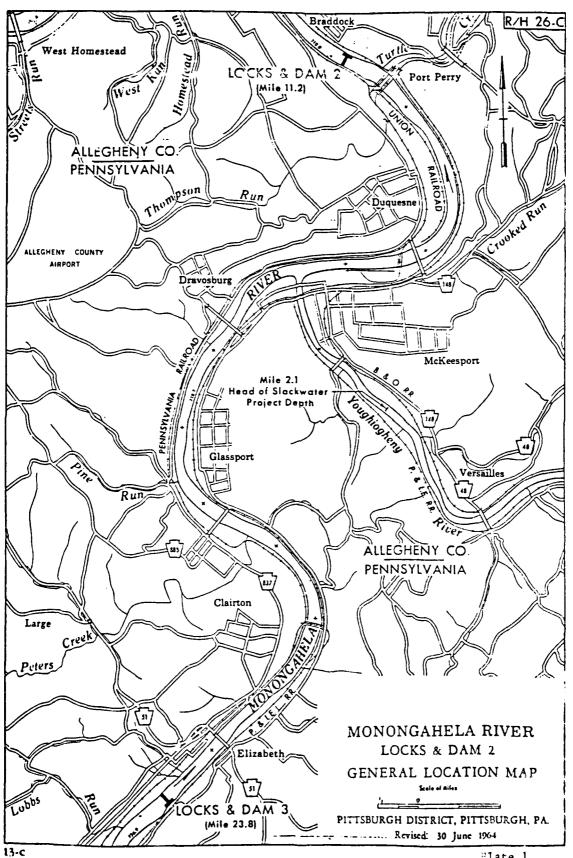
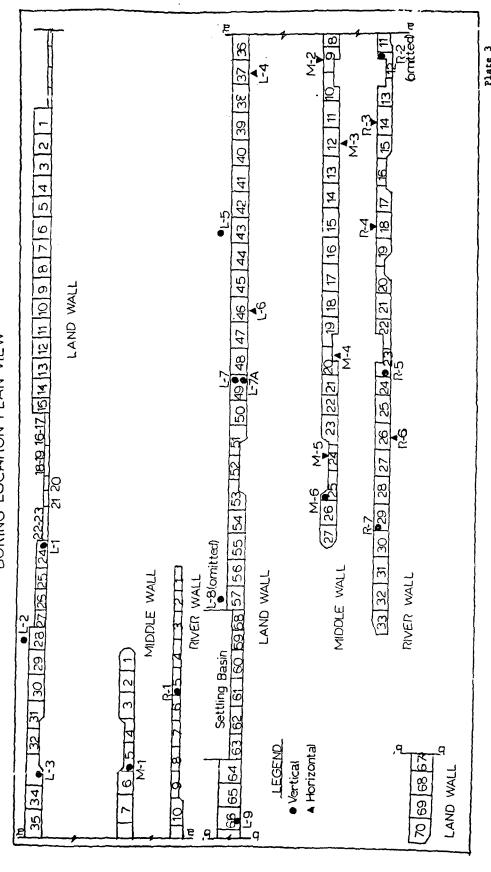
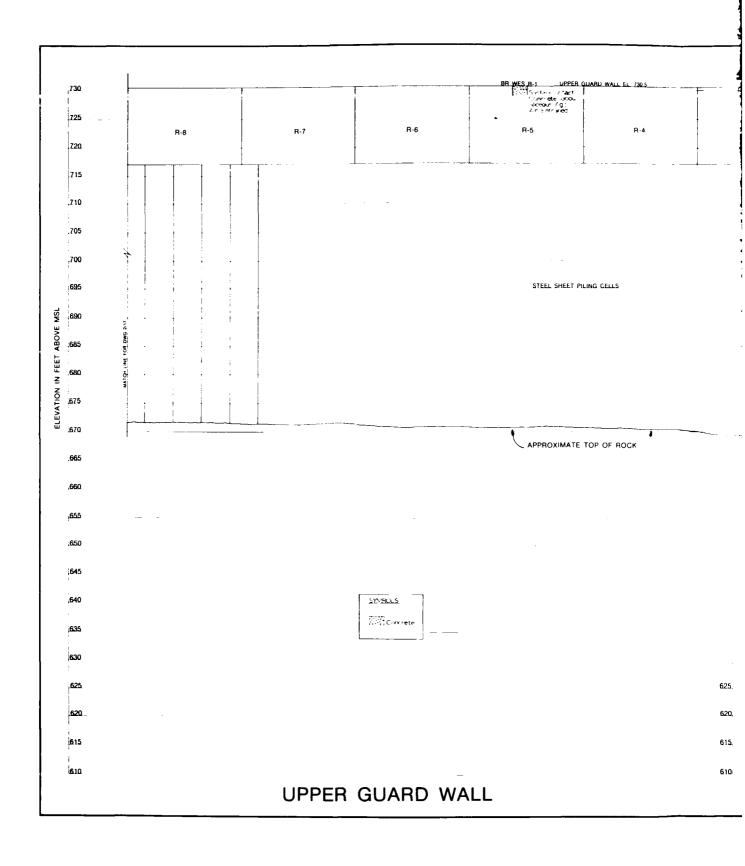


Plate 1

Plate 2

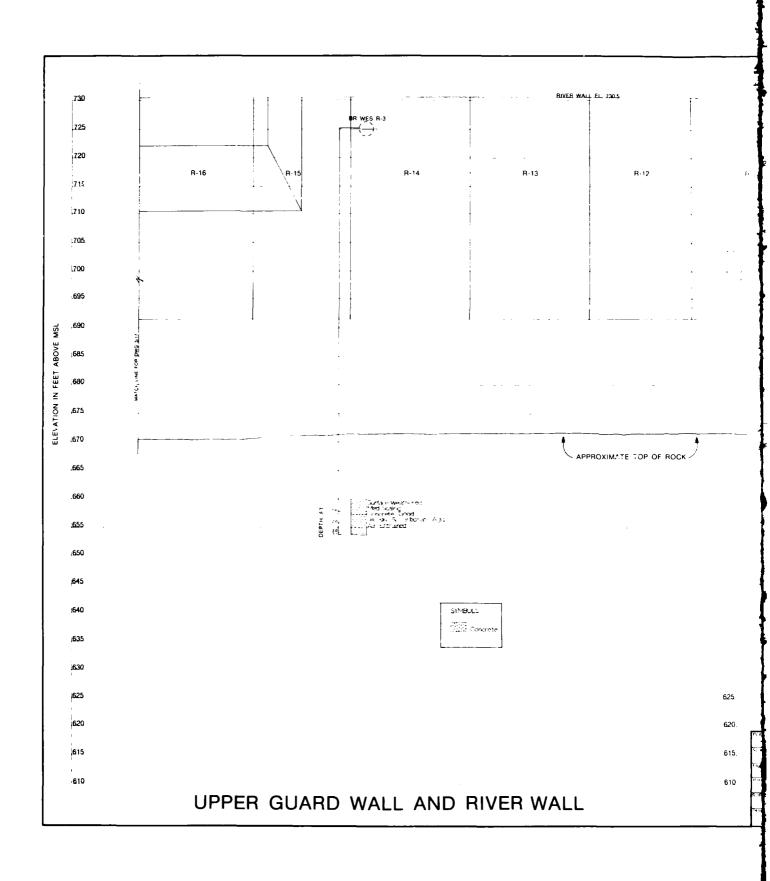
MONONGAHELA RIVER, LOCKS AND DAM NO. 2 BORING LOCATION PLAN VIEW





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615, SCALE	LOCKS AN	O RIVER ID DAM NO 2 BILITATION	PREPARED FOR  US ARMY ENG DIST PITTSBURGH  OFFICE OF DIST, COMMANDER  PITTSBURGH, PENNSYLVANIA
FILE NO AS SHOWN		N EXPLORATION  UARD WALL	PREPARED BY US ARMY ENGINEER DIST VICKSBURG
SUBMITTED MCISH ON		R FACE	CORPS OF ENGINEERS OFFICE OF DIST. COMMANDER VICKSBURG, MISSISSIPH
(Control of the control of the contr	MONOLITHS R-1	TO R-8	DWG 1 OF 17

PLATE 4



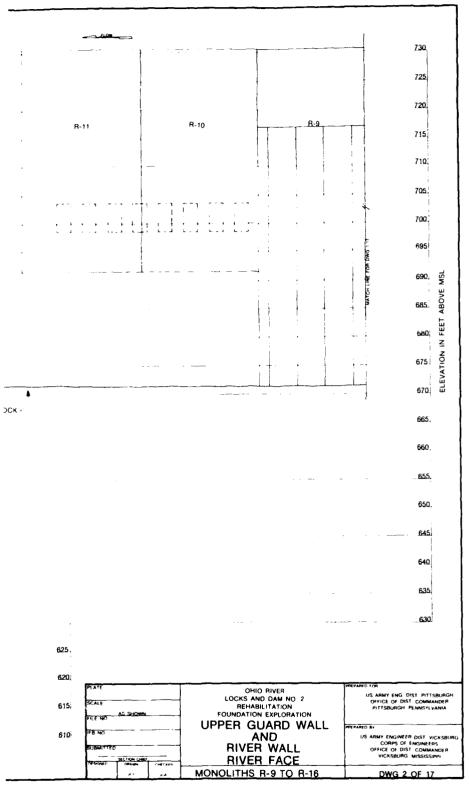
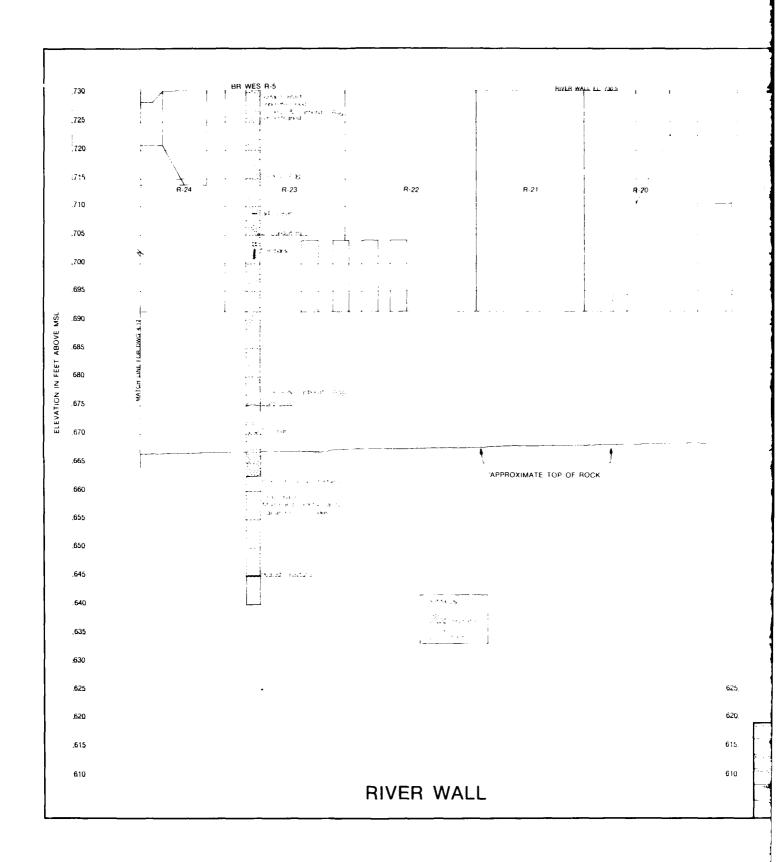


PLATE 5



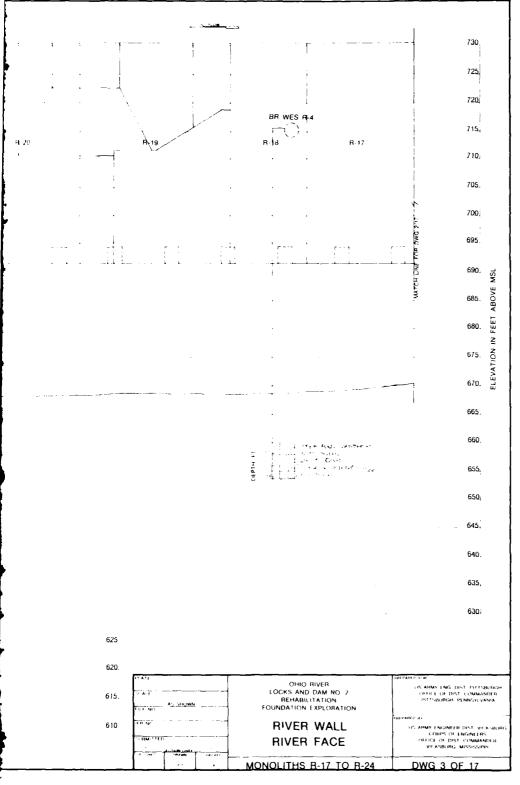
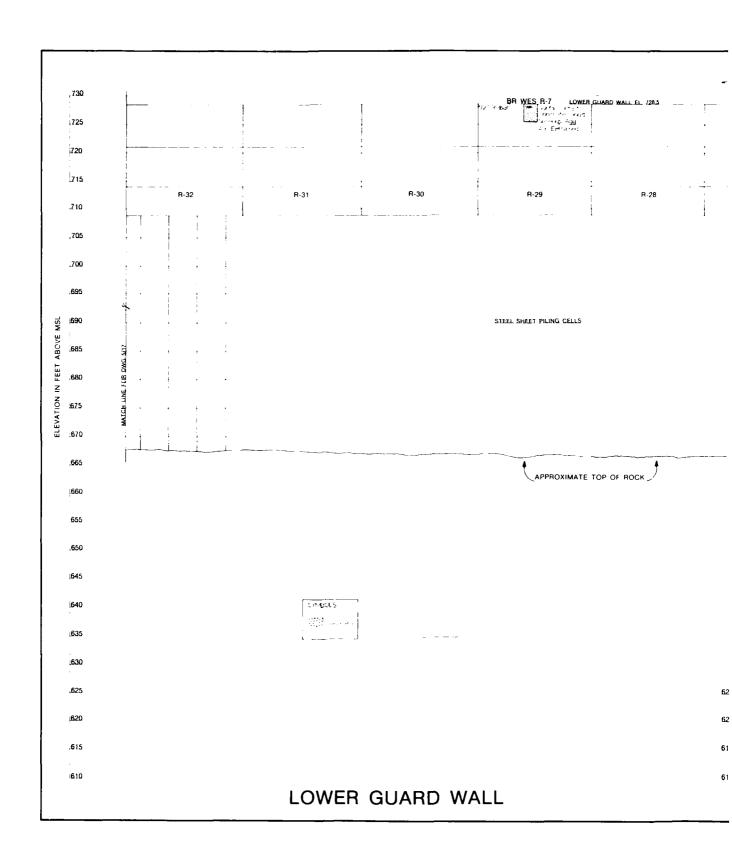


PLATE 6



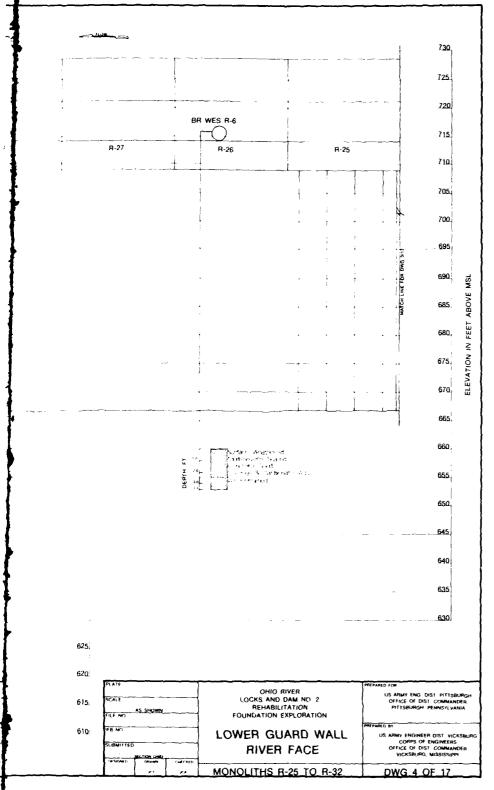


PLATE 7

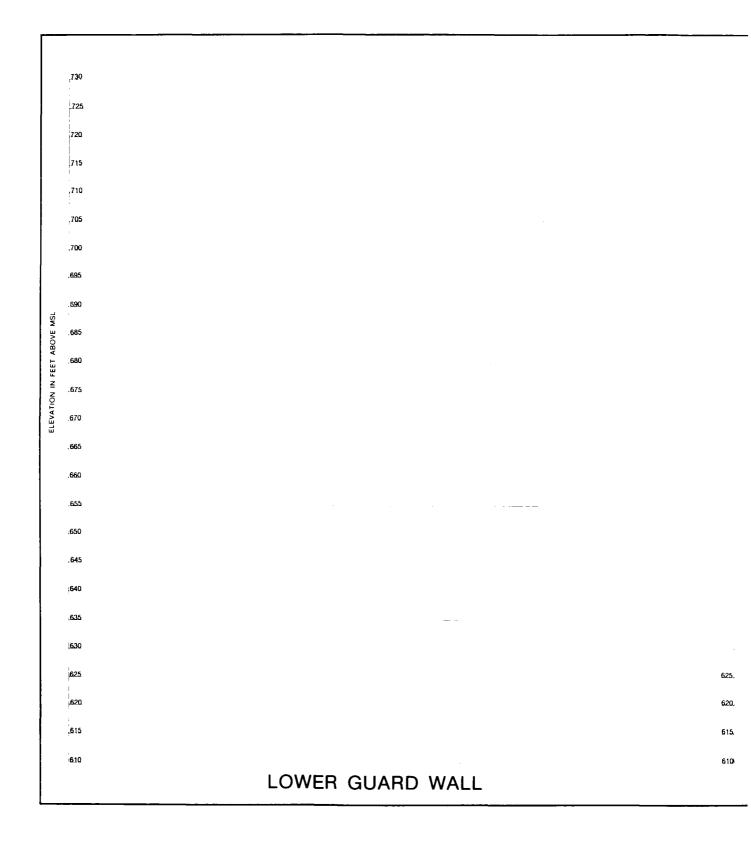
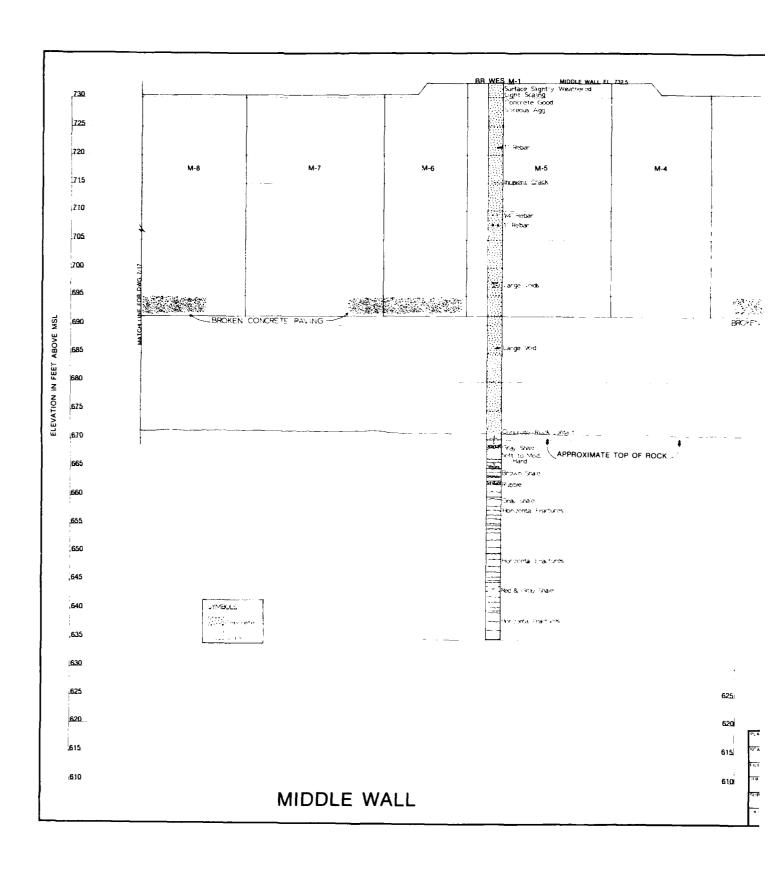
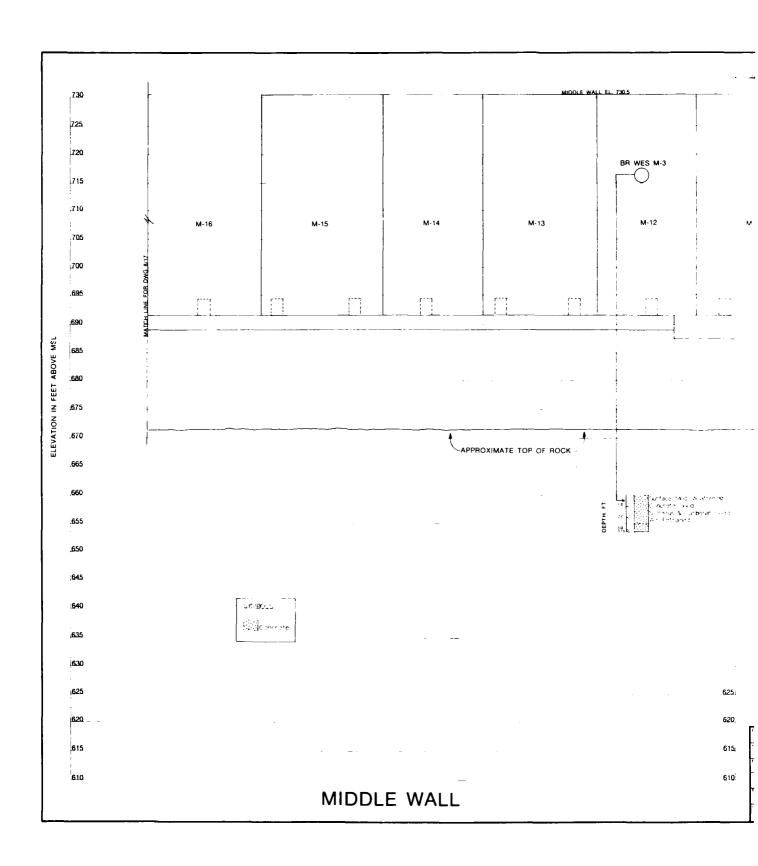


PLATE 8



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	PLATE	OHIO RIVER LOCKS AND DAM NO 2	PREPARED FOR US ARMY ENG. DIST. PITTSBURGH
	FILE NO. AS SHOWN	REHABILITATION FOUNDATION EXPLORATION	OFFICE OF DIST COMMANDER PITTSBURGH PENNSYLVANIA
	610 FR NO	MIDDLE WALL	PREPART BY  US ARMY FINGINEER DIST VICKSBURG  CORPS OF ENGINEERS  OFFICE OF DIST COMMANDER
		RIVER FACE MONOLITHS M-1 TO M-8	VICKSBURG MISSISSIPPI
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PLATE 9



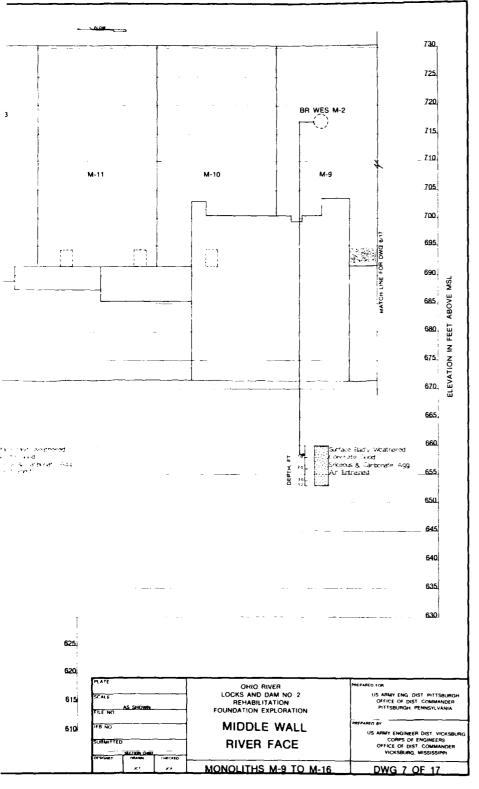
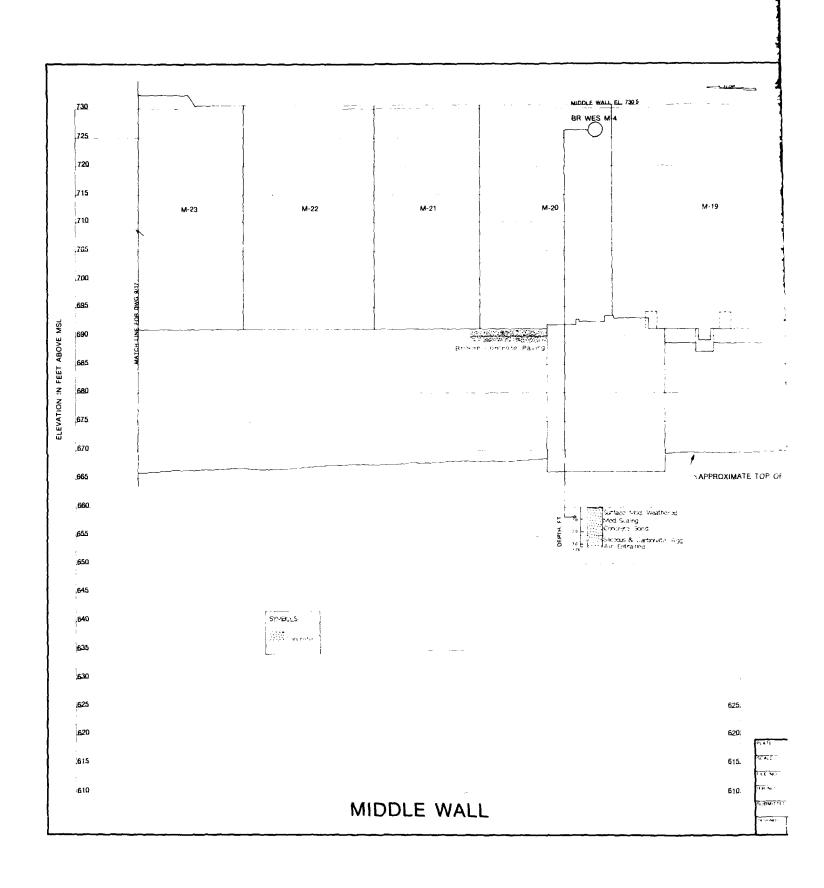


PLATE 10



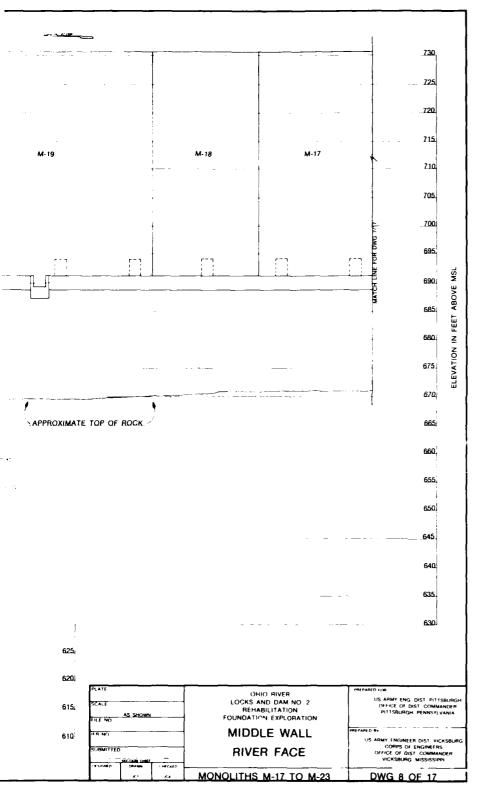
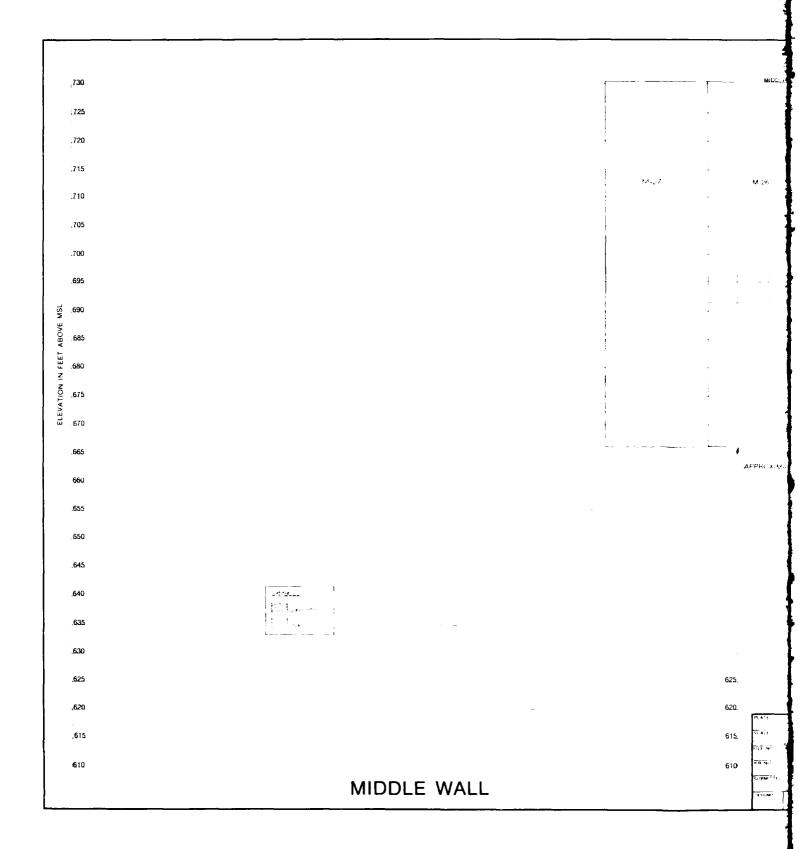


PLATE 11



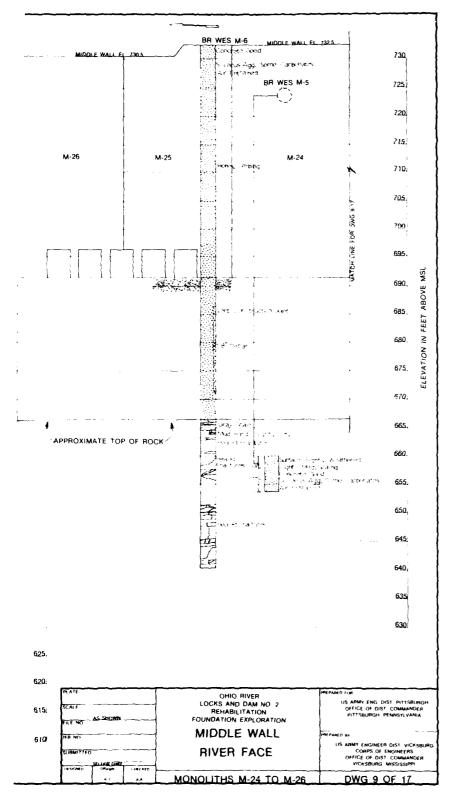
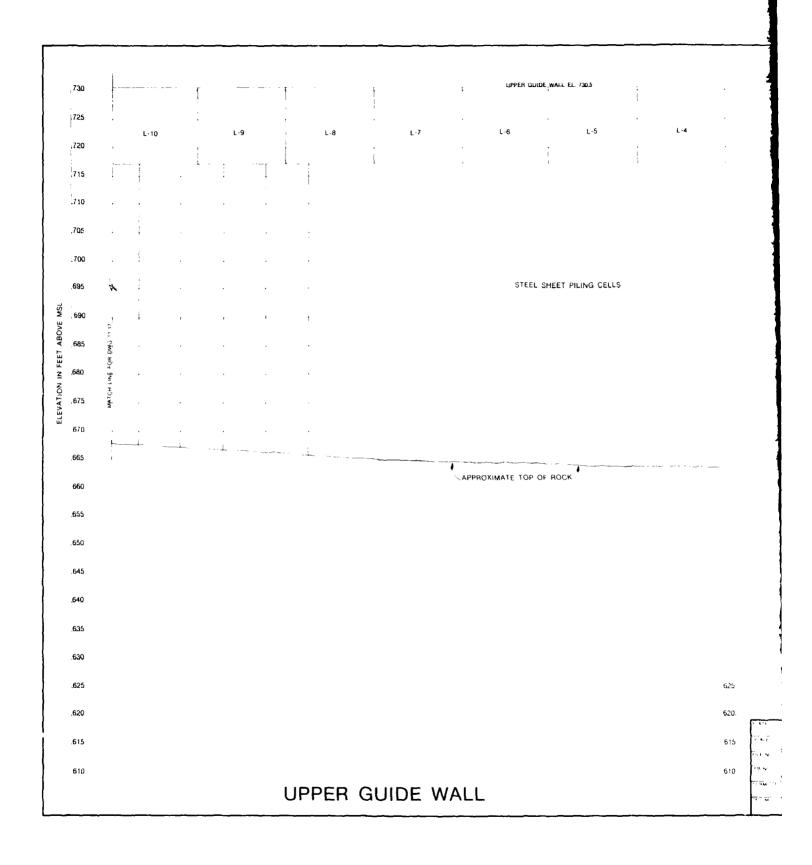
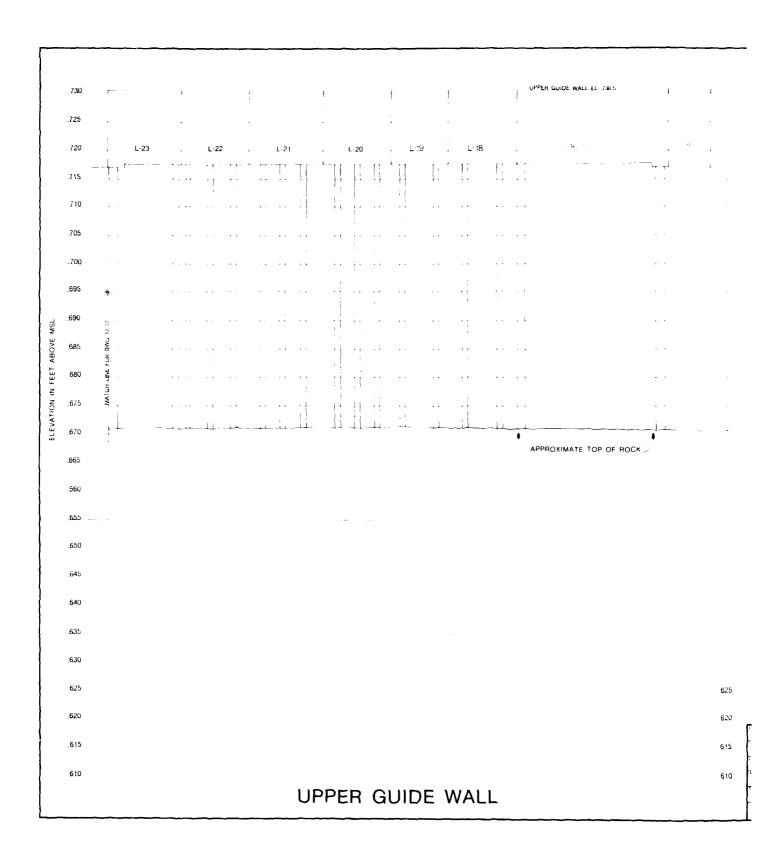


PLATE 12



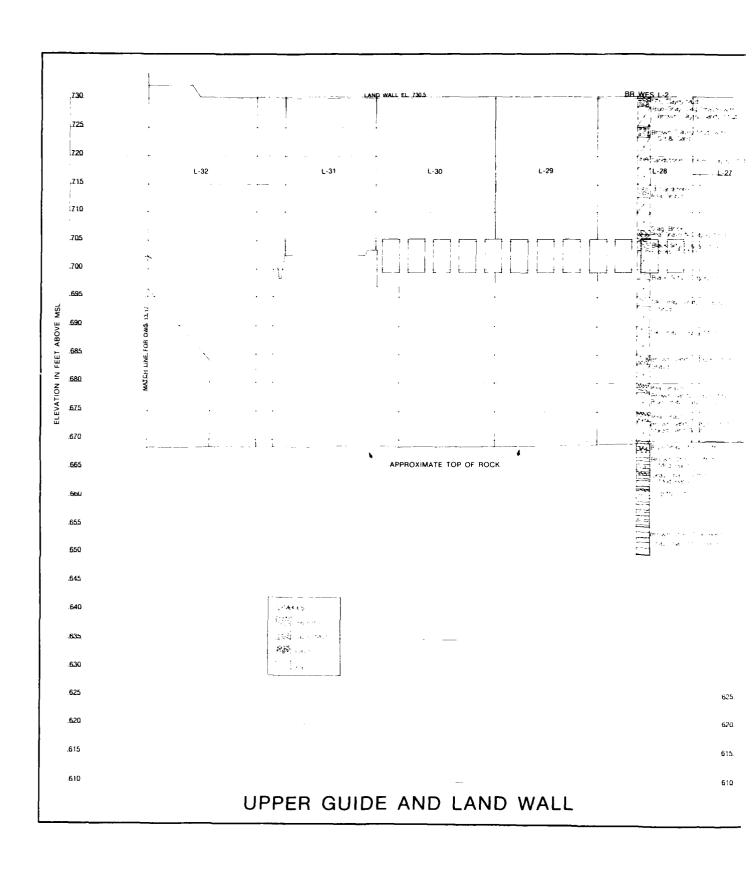
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PLACE 13



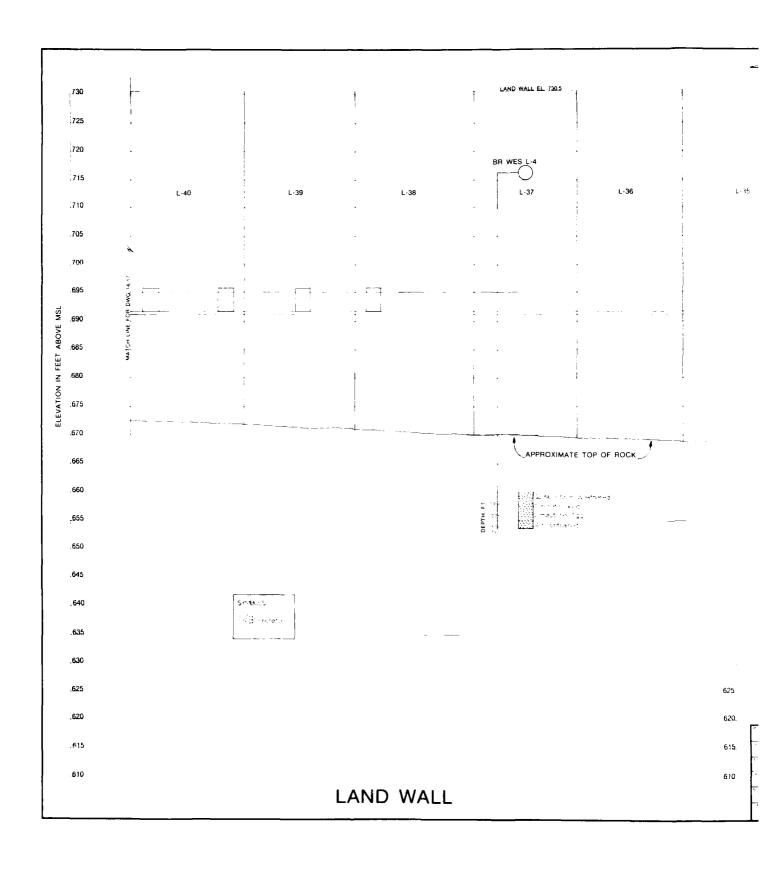
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PLATE 14



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PLATE 15



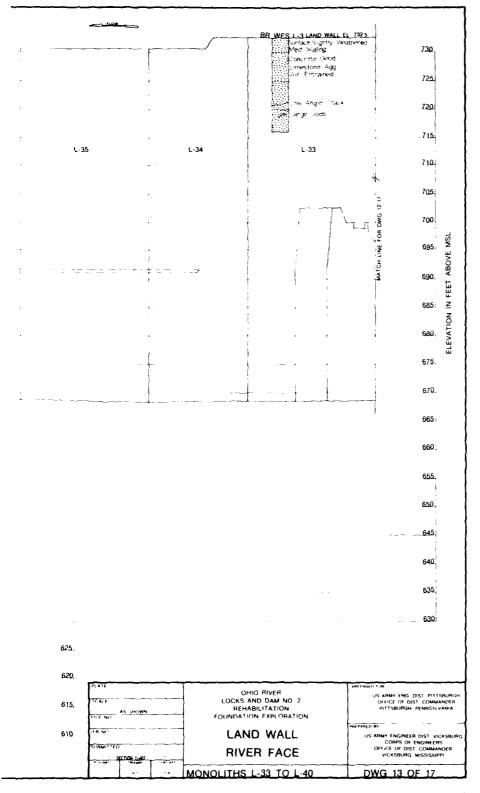
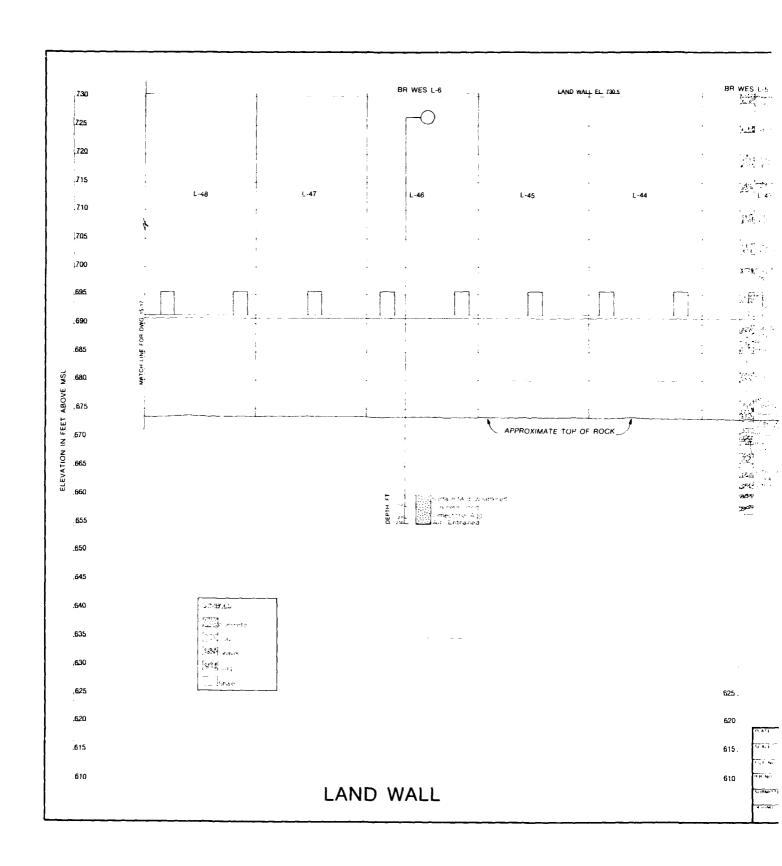
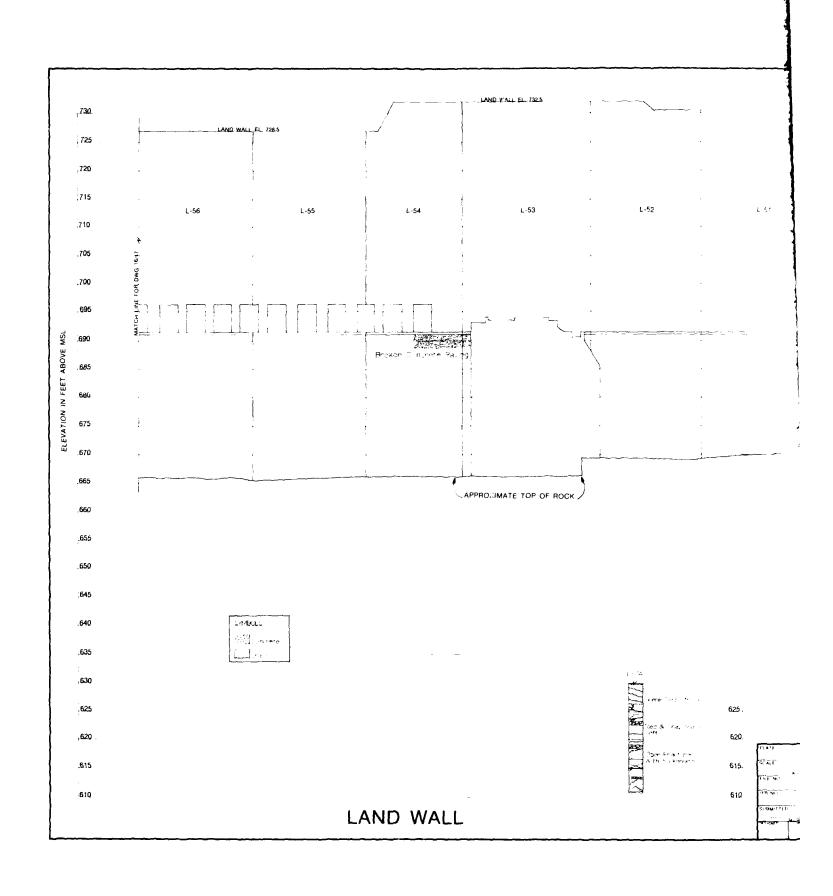


PLATE 16



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SUBMITTED SET	RIVER FAC		CORPS OF ENGINEERS  OFFICE OF DIST. COMMANDER  VICKSBURG MISSISSIPPI
A NOTE OF STATE OF ST	MONOLITHS L-41 TO		DWG 14 OF 17

PLATE 17



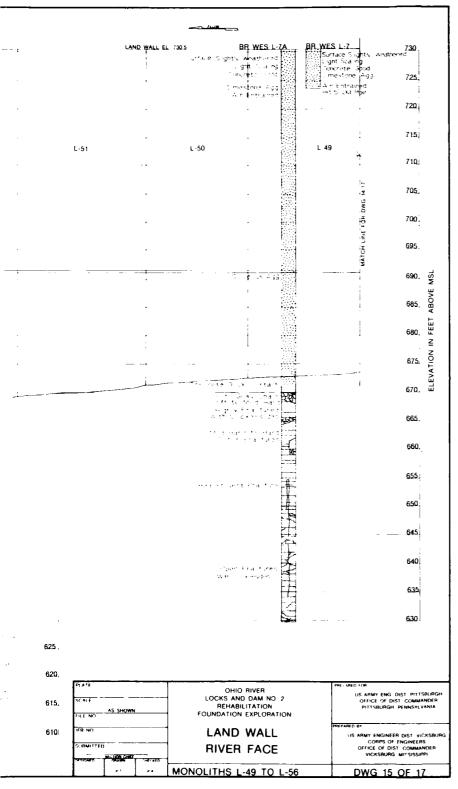
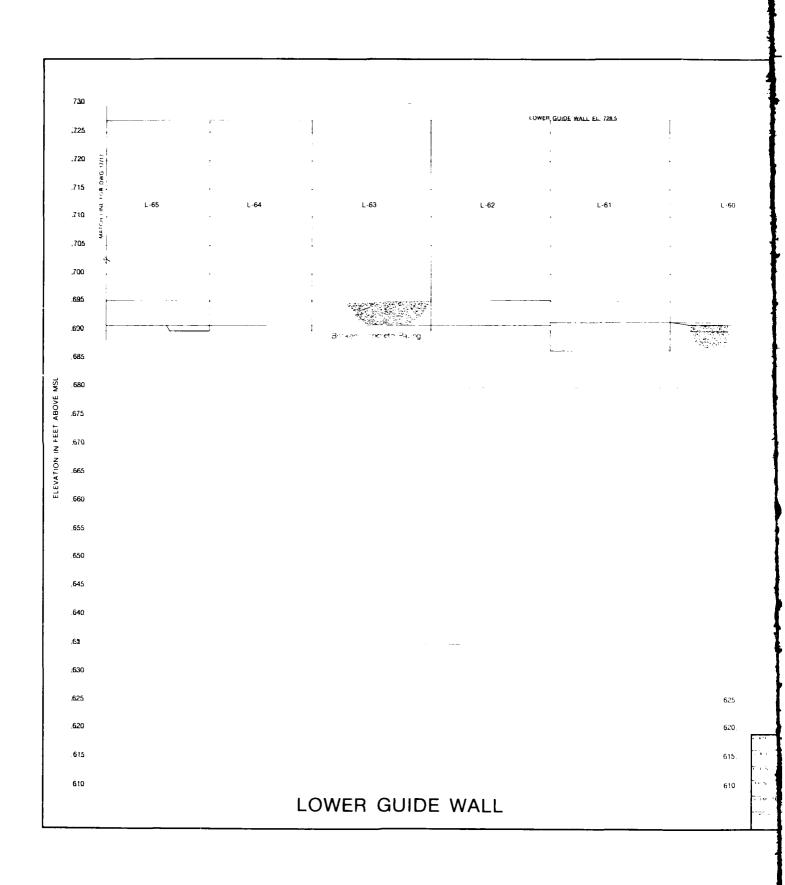


PLATE 18



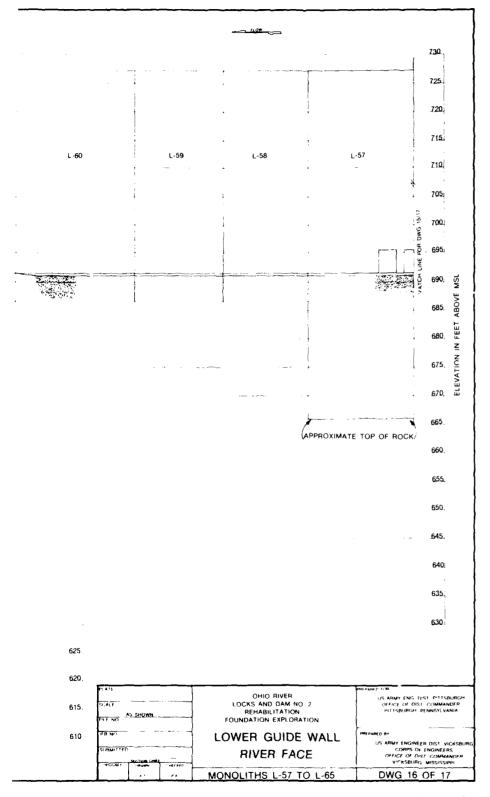
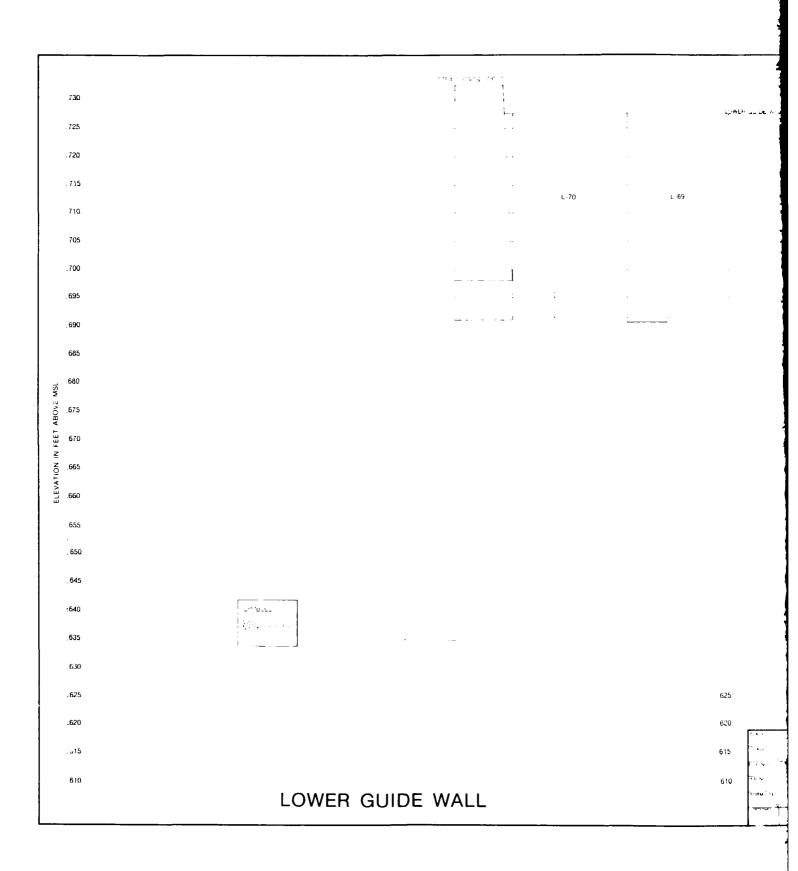
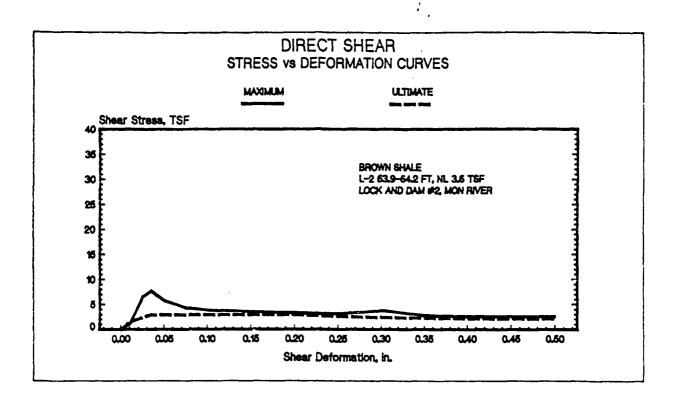
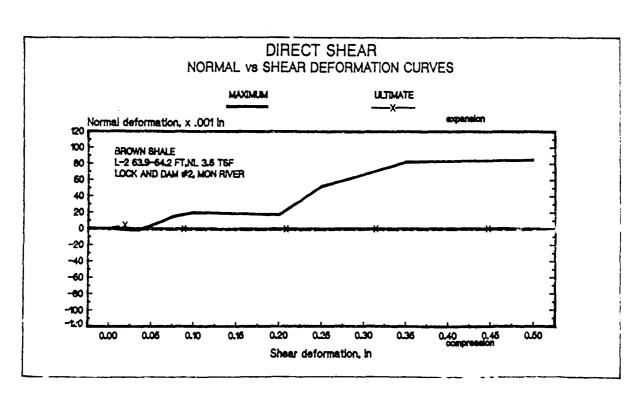


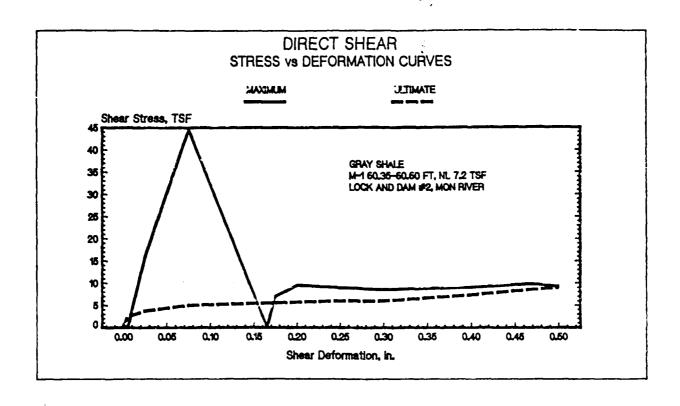
PLATE 19

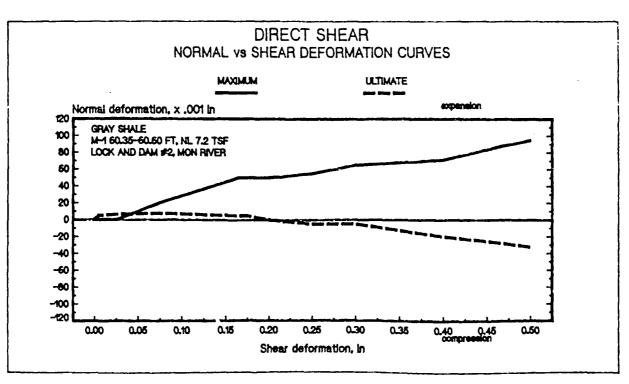


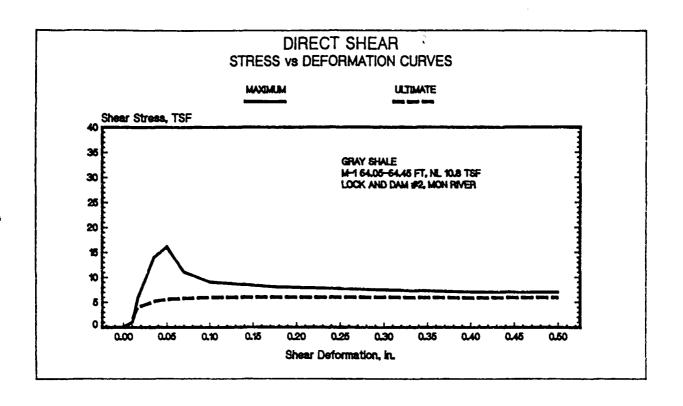
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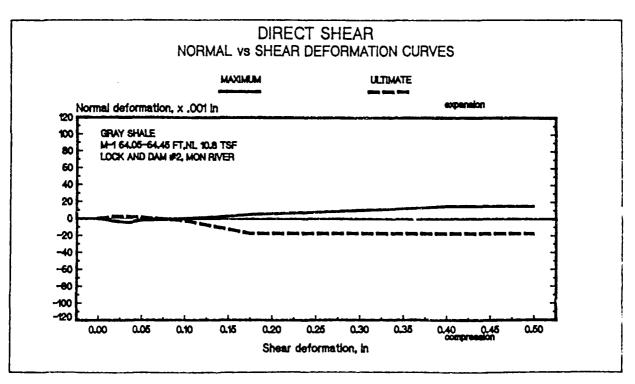


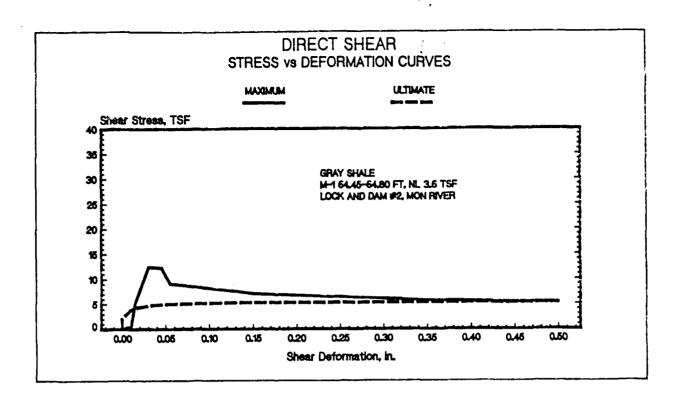


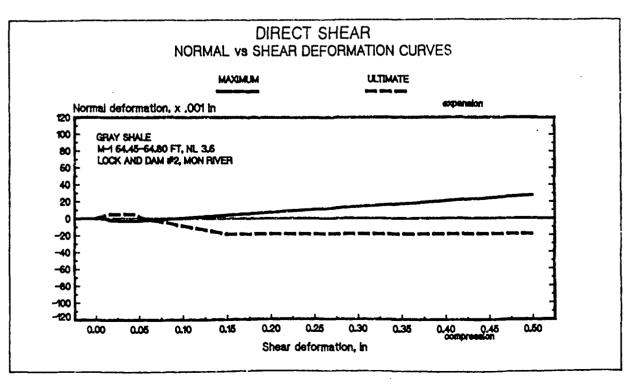


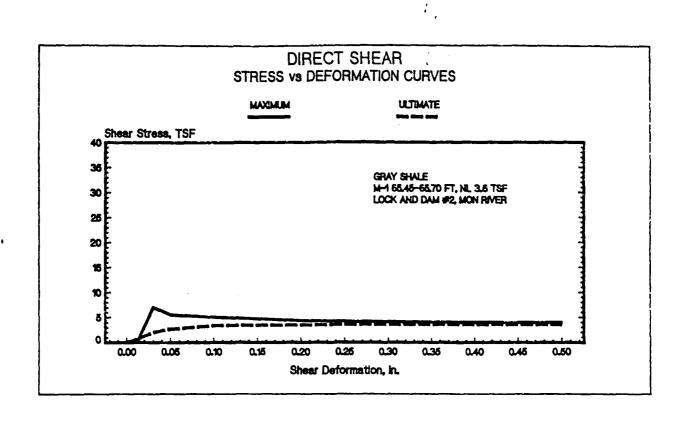


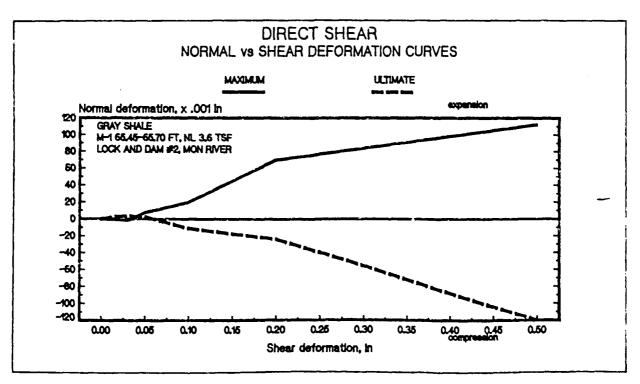


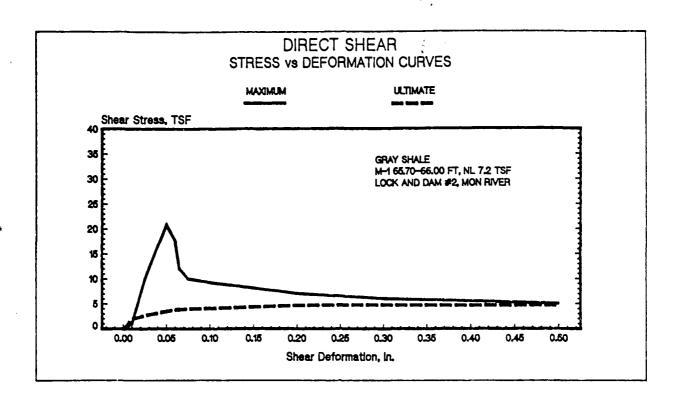


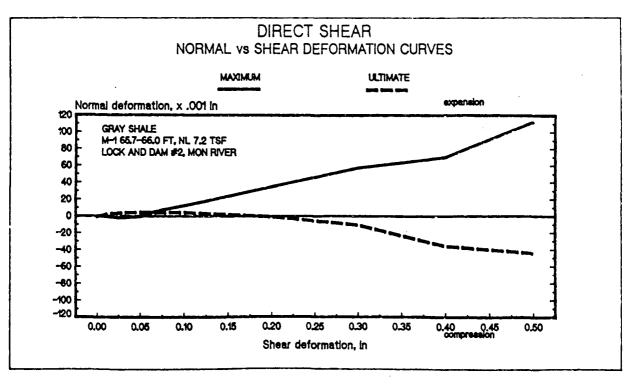


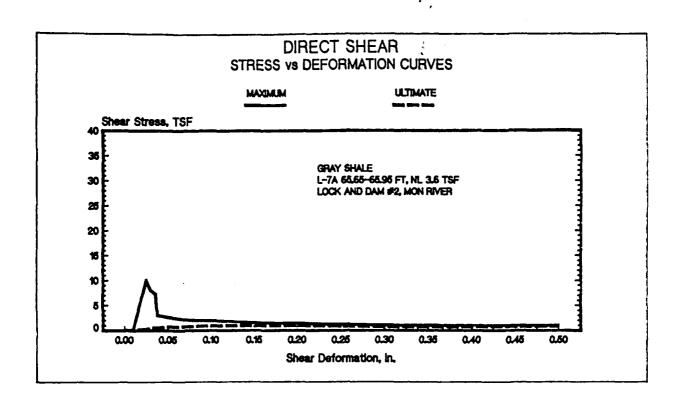


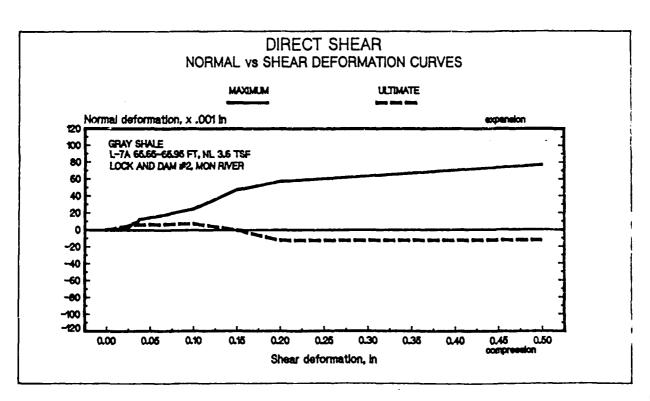


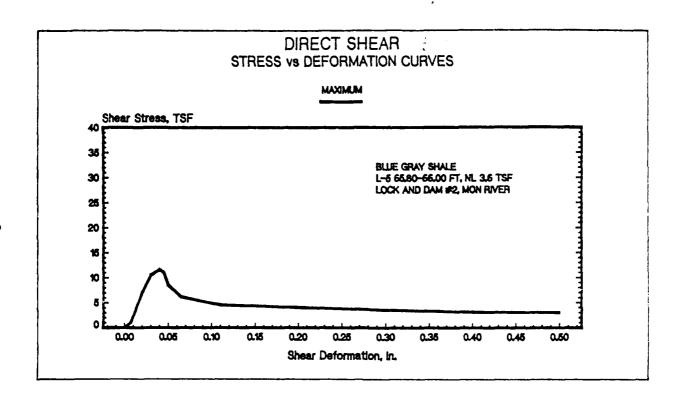


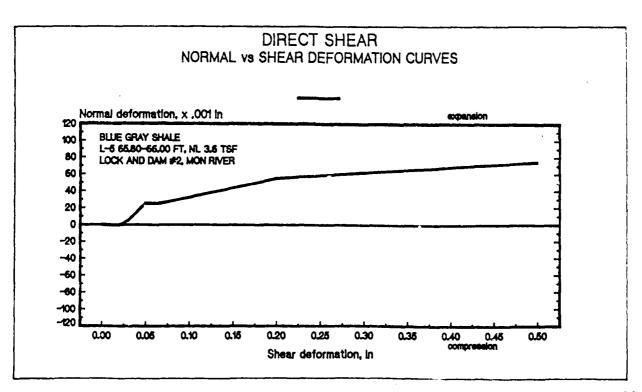


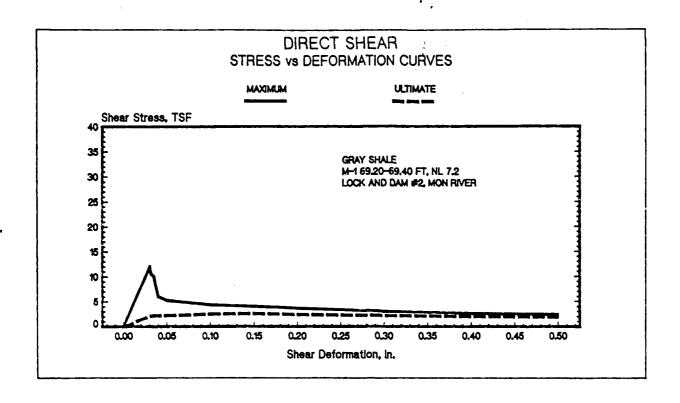


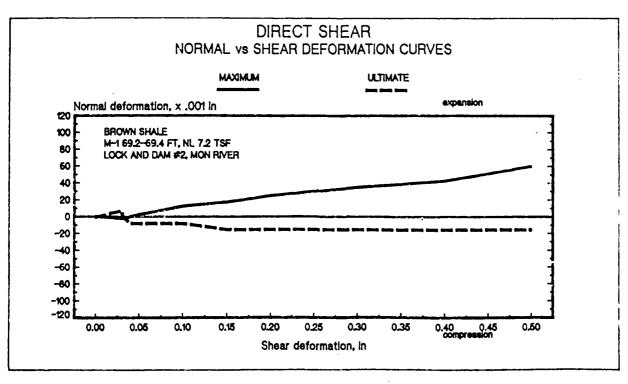


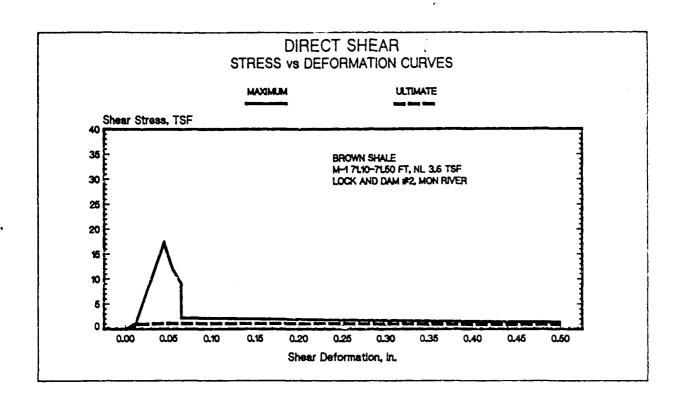


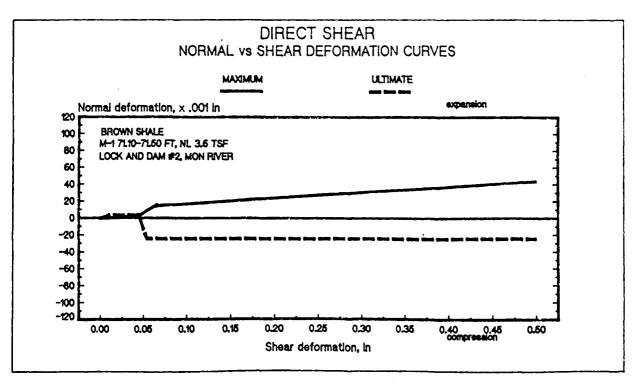


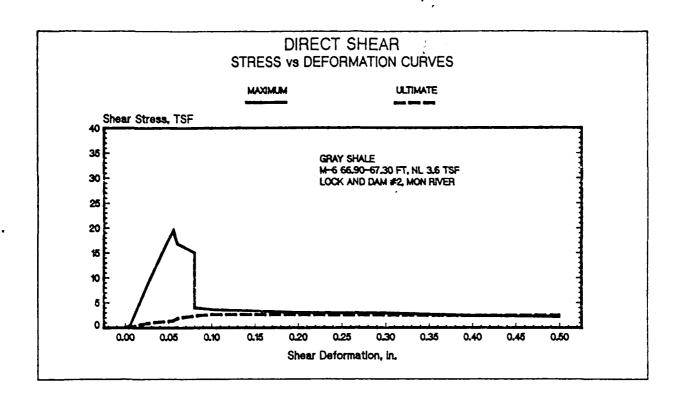


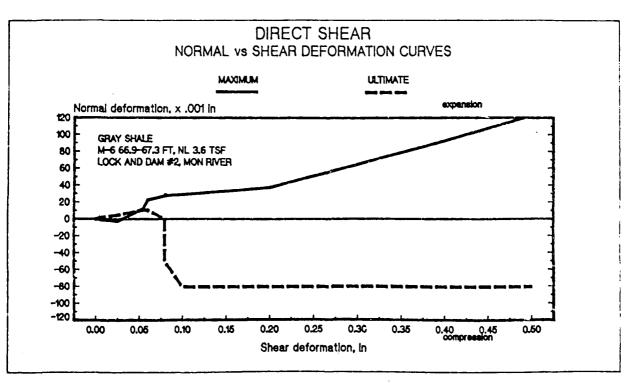


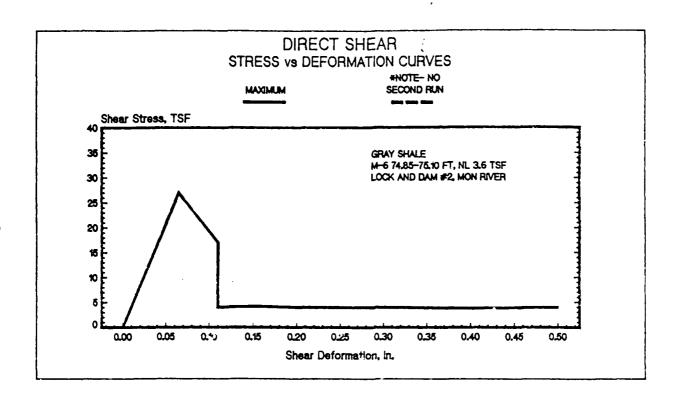


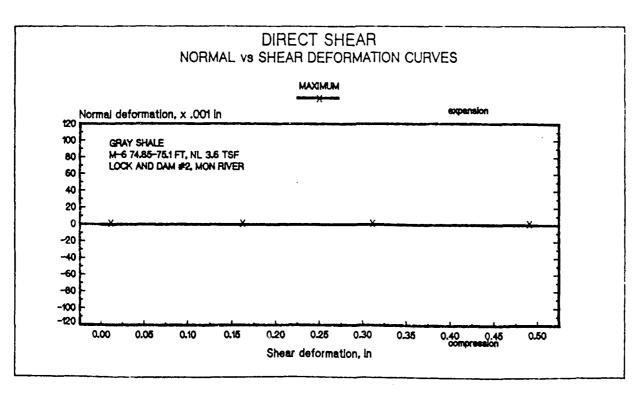


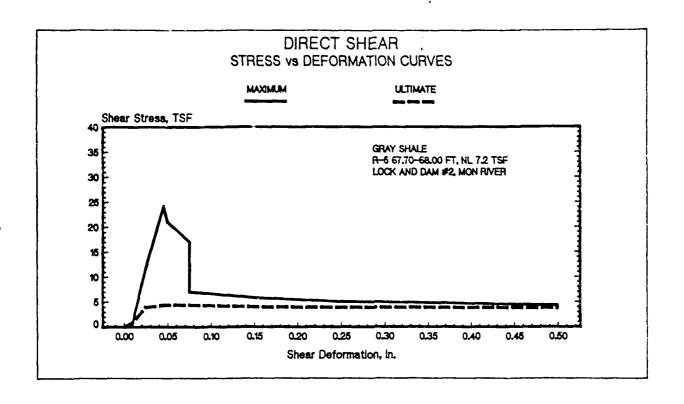


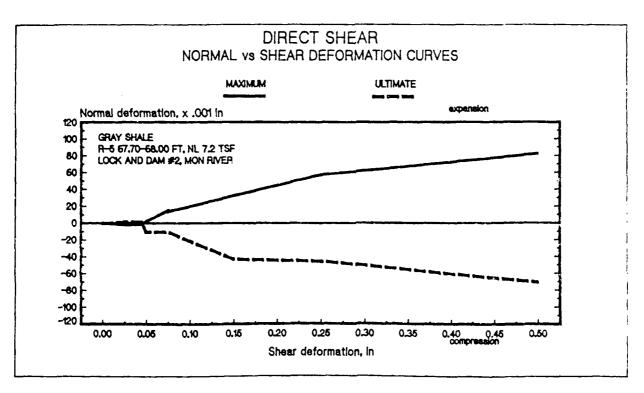


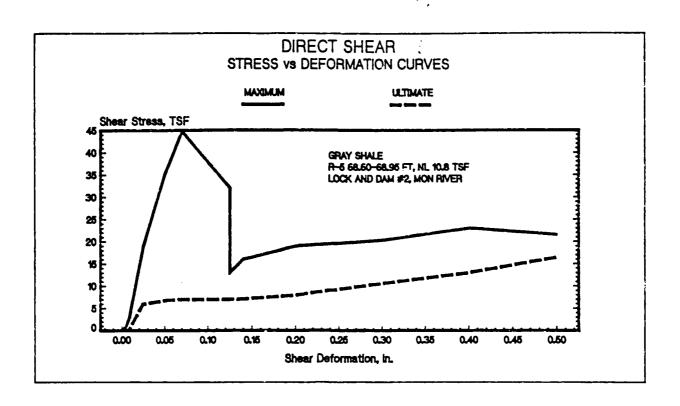


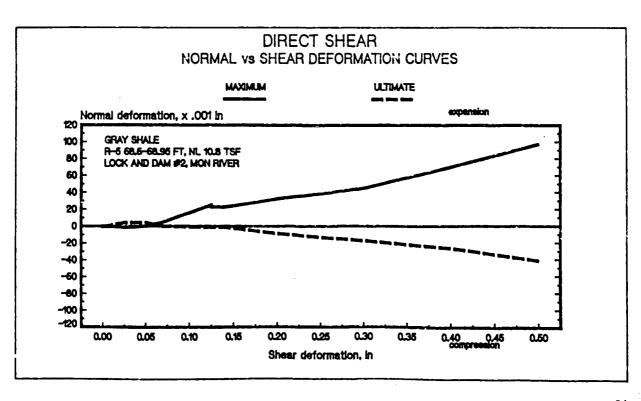


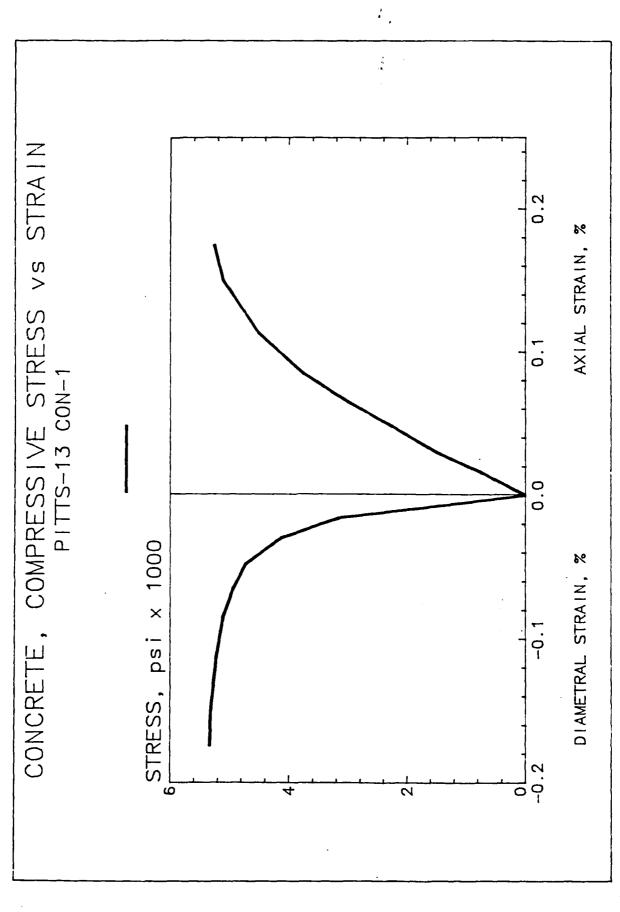


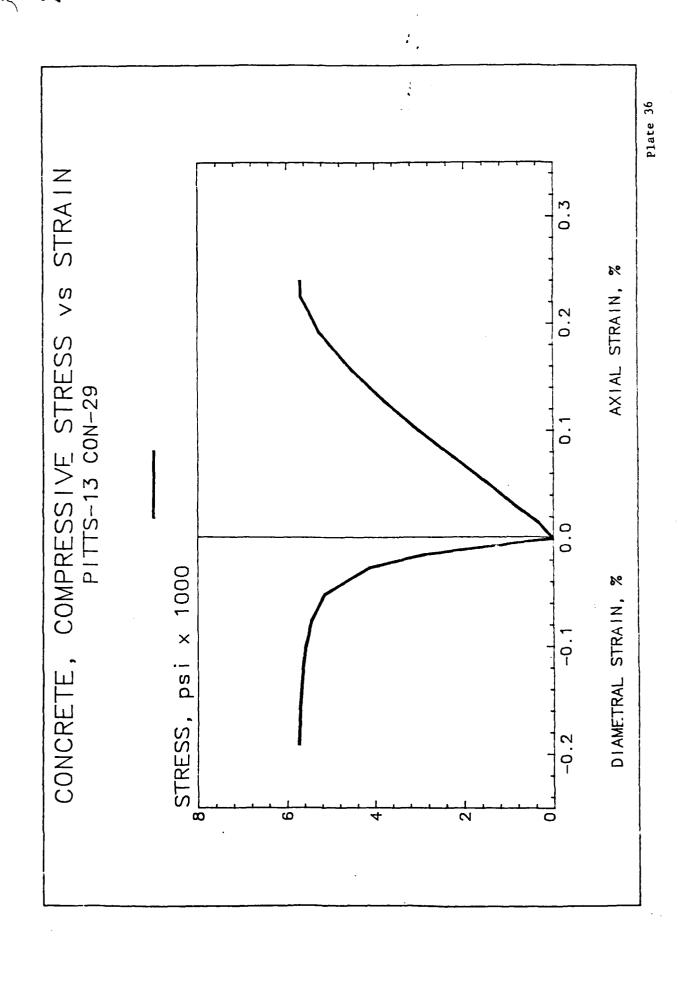


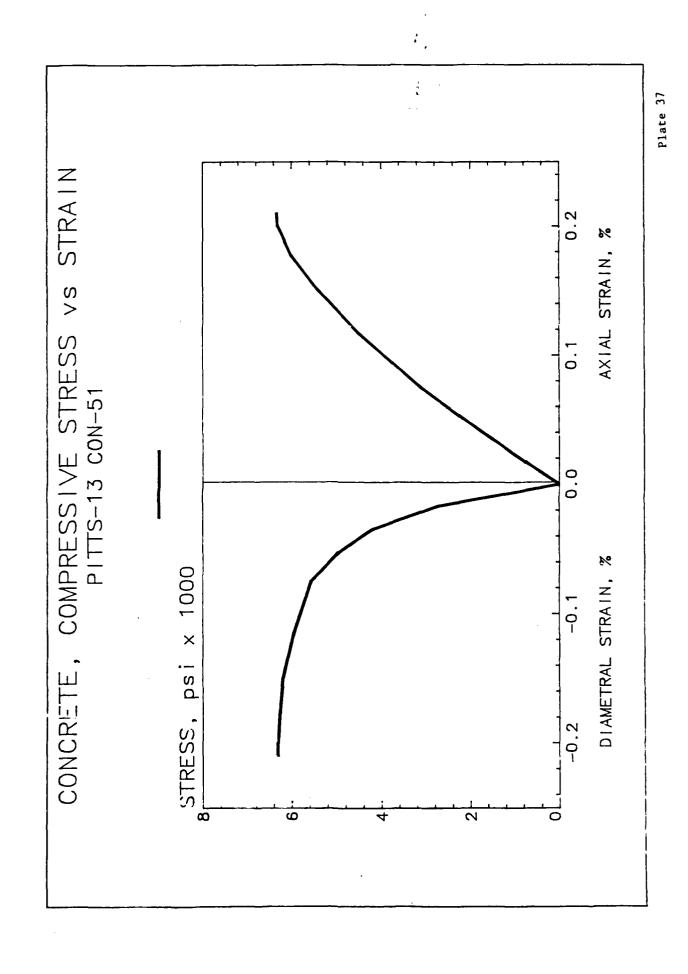


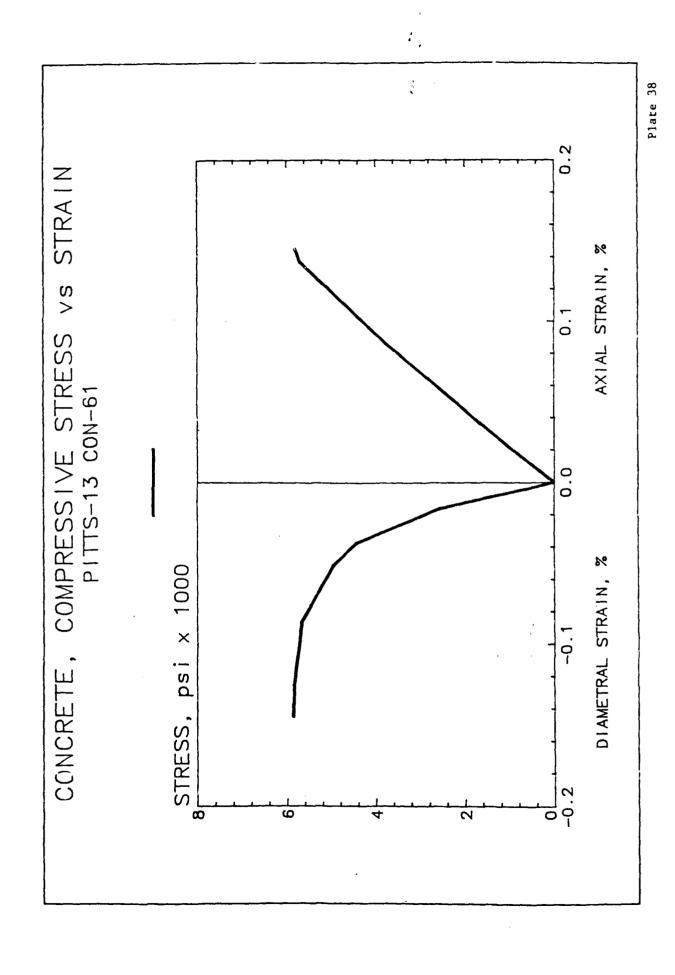


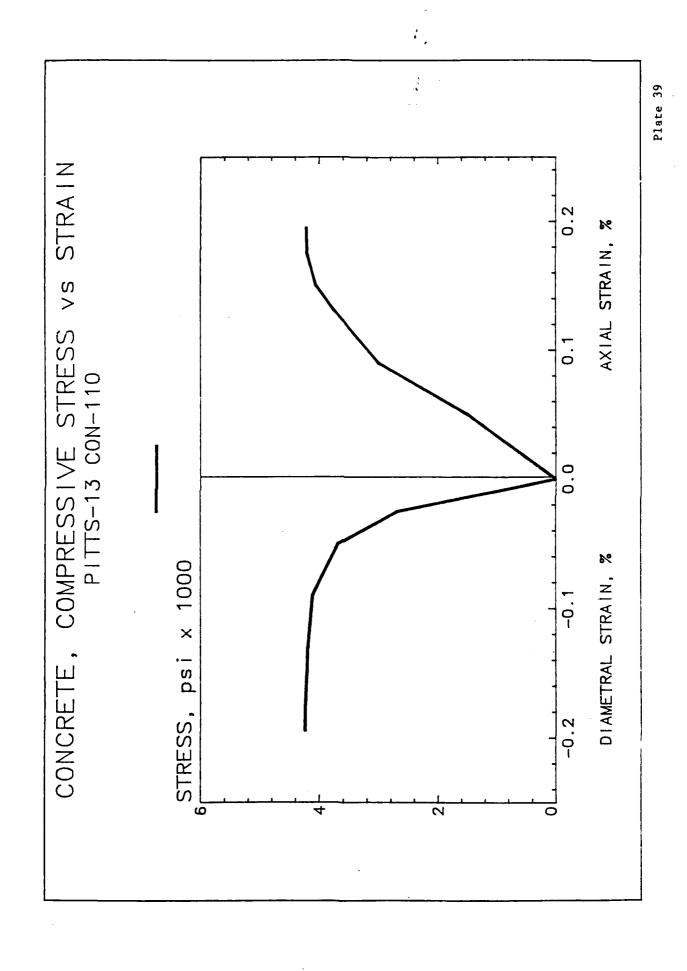












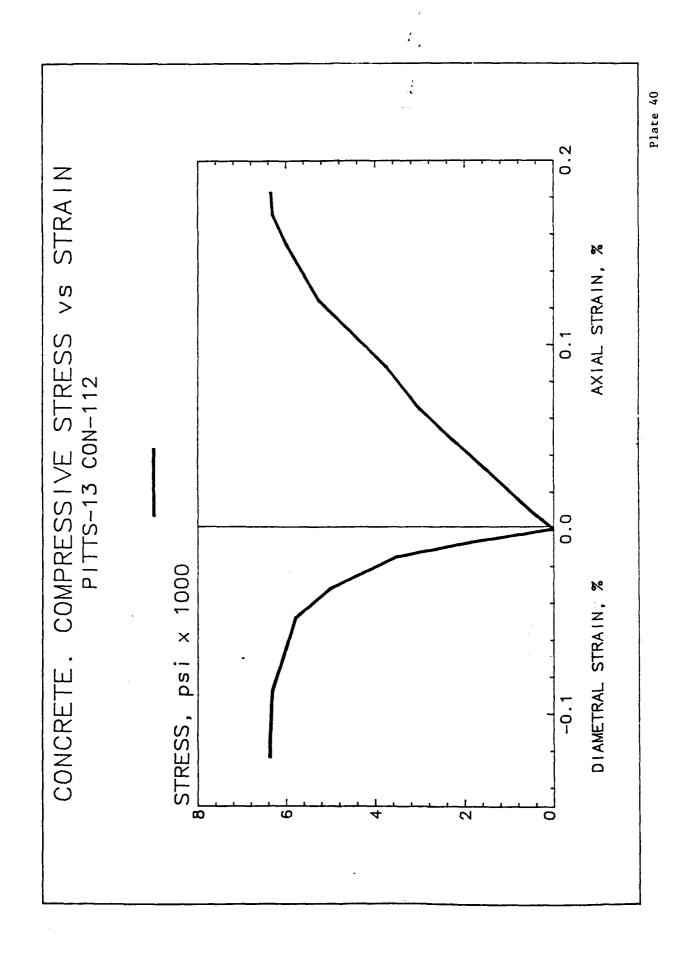


Plate 41

				>							·			
	•	Vertical Boring Locations		E 6 × 10 6										
	•	Vertical Locations		Comp Strg ps1										
		Ver 1.00		Vp (ps									· .	
	Flow			Unit. Vt. Pcf										
<b>0</b> L-2			BR WES L-5	Material	Concrete, 1:0' LS agg	Air Entrained	SS gravel and clay	Slay and	1/2" - 4" Mud, pea	slag, SS Shale- blue-gray	Soft to mod. hard	Low angle breaks		
			- BR	Leg-									•	
1ES . 2 er	M		R No.	Սշրքի 30.5	111	0.1	2.0	3.0	4.0	5.0	6.0	7.0	<del>                                     </del>	
CONCRETE PROPERTIES Locks and Dam No. 2 Nonongahela River			Boring No.	E.Lev	•	<u>-</u>								
CRETE F	L-5			2										
CONC				Е * 10 ps1								_		
	M			Comp Strg ps1	— <u>-</u> -					····				
				γρ I ps			····							
				Valt Vit			•							
		_	BR WES L-2	Haterial	Mud and Sand	Clayey mud	Slay and SS gravel		Sandy mud with pea	gravel	Shale-gray and brown	Soft to mod. hard	Low angle breaks	
Jandwall			BR WE	Leg- end										
	İ	No Scale	Boring No.	nept ft	1111	्	0.2	 1				0.	0.8	
		NO NO	Borfi	Elev 222_0							,			

= -	Horizontal Moring	Locations	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	<u>×</u> -	15755 6770	
	Flow	ī	1 1 1 1 1			
	П		BR WES L-6	Leg- Material	Surface Weathered Concrete good LS agg, max 3", crushed Air entrained	
OPERTIES am No. 2 a River	√ P4 ₽		Borlug No.	Elev Depth L. 726.5		
CONCRETE PROPERTIES Locks and Dam No. 2 Monongahela River	r-6 \$			v 10 <sup>6</sup> v		
			Comp	νρ f ps	16652 4460	
			Unite	Pcf	150.6	
			BR WES L-4	Material	Surface Weathered Concrete good LS. agg, max 2", crushed Air entrained	
Landwall			BR WE	Leg- end		
Lar		No Scale	Boring No.	, Depth	infututututututututututututututututututut	
·		N N	Bor	Elev 715.5		

Plate 44

	œ	2						
	Vertical Boring Locations	E 6 × 10 6 ps 1						
	Vertical Locations	Comp Strg ps1		<u> </u>				
	Ve	ν γρ ( ps						
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		Material			·			
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CONCRETE PROPERTIES Locks and Dam No. 2 Monongahela River L-7A		Elev Depth			•			
CRETE ks and nongah		>		0.16	·			
CONC Lock Mon		E 106		3.0	·			
		Comp Strg ps1		5790	·			
		d y g l	<del></del>	13912	····			
		Unit We per		146.4				
	]	Haterial	Surface scaled Concrete good	LS agg, max 3", crushed changes to Siliceous agg at 39.5"	Air entrained Shale-gray and red	Soft to mod.	inin, flat, bedding	
Landwall		Leg- end						
Lan	No Scale	Jept ft	0.00	2 0.2	\$		77 77 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	
	No Scale	Elev 230.5				01	12	

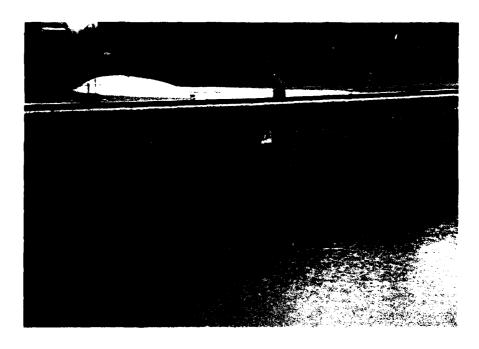
			>	0.52	
	Horizonral Boring Locations		E 6 × 10 6	4.4	
	rizontal Locations		Comp Strg ps1	6020	
	Hor 1z		ην γρ	i	
	Flow		Vale Ve Pcf	145.2	
		BR WES M-3	Material	Surface Weathered Concrete good LS and Siliceous agg, max 3" Air entrained	
		BR	Leg- end	i :	
IES . 2 er	03	g No.	เวะคะเห	3.0	
CONCRETE PROPERTIES Locks and Dam No. 2 Monongahela River	3 OF S	Boring No	Elev 716.3		
RETE ps and ongahe	M-3		>		
CONC Lock Mon			r, 10 r 10		
	$M \mid I \mid$		Strg psi		
			Vp f ps		
			Wr. Pef		
		3 M-2	Material	Surface Weathered Concrete good LS and Siliceous agg, max 4" Air Air	
Landwall		BR WES M-2	Leg- end		
Lan	No Scale	S. No.	Depth ft		
	o X	Boring No.	Elev 717.1		

	Ext	2	
	Borin	E E 6	
	Horizontal Boring Locations	Comp Strg usi	
	Horiz Loc	ην	17
	Flow	Unit Vt pcf	
		WES R-4 Material	Surface weathered Concrete good LS and siliceous agg, max 3" Air entrained
		BR Leg-	
IES . 2 sr	R-3	R No.	
CONCRETE PROPERTIES Locks and Dam No. 2 Monongahela River	(+O)	Boring No.	
RETE PI s and I	R-4 (O	2	0.24
CONCI		E 6 × 10 6 ps 1	4.5
	$M \mid I \mid$	Comp Strg ps1	6830
		d y l	! <b></b>
		Unit We pef	148.3
		R-3 Haterlal	Surface weathered Concrete good LS and siliceous agg, max 3" Air entrained
Landwall		BR WES	0
Lan	No Scale	ng No. Depth ft	
	8	Horing No Elev Depti 725.3 ft	

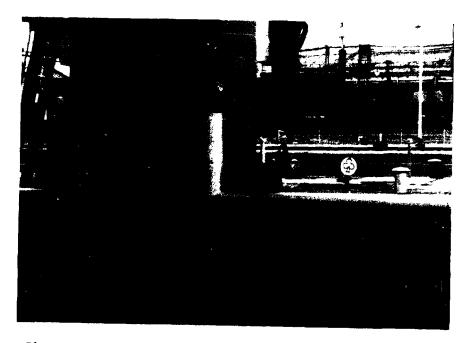
APPENDIX A: PHOTOGRAPHS TAKEN DURING PRELIMINARY STUDY



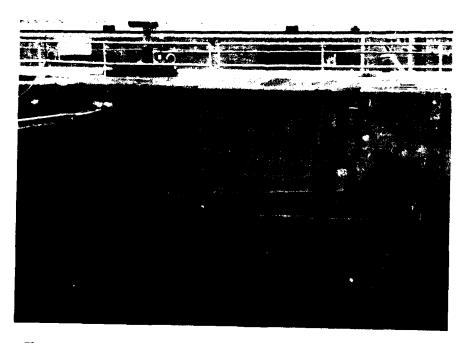
Photograph Al. Land wall lower gate recess



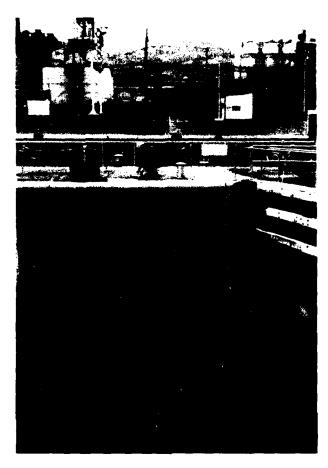
Photograph A2. Land wall lock chamber of large lock



Photograph A3. River face middle wall at monolith M-5



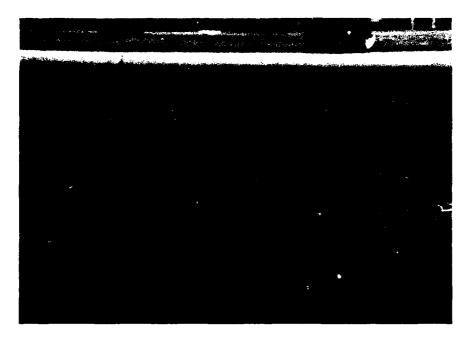
Photograph A4. Gate recess river face middle wall of upper gate in small chamber



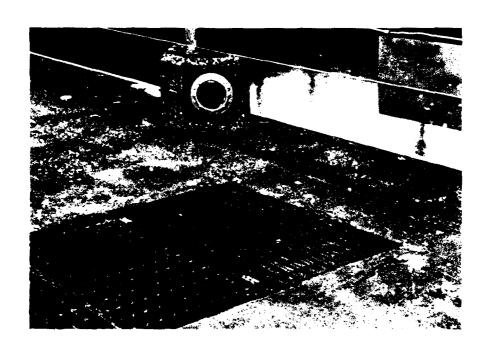
Photograph A5. Downstream of upper gate middle wall in small lock chamber



Photograph A6. Middle wall small lock chamber

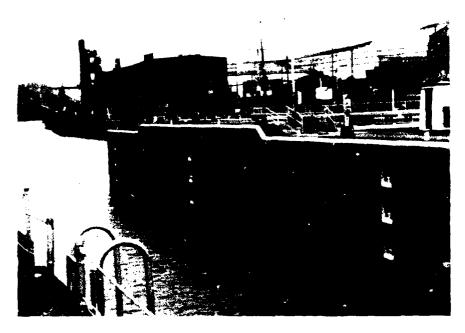


Photograph A7. Middle wall small lock chamber monolith M-16

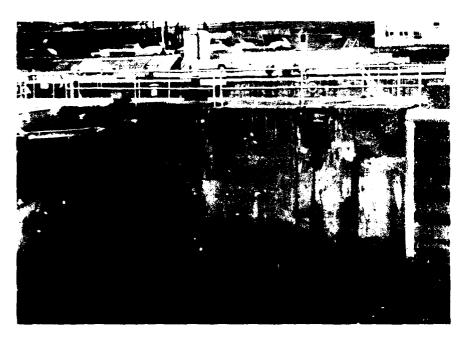




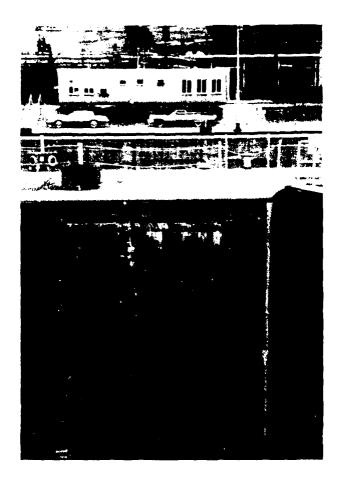
Photographs A8 & A9. Middle wall monolith M-22



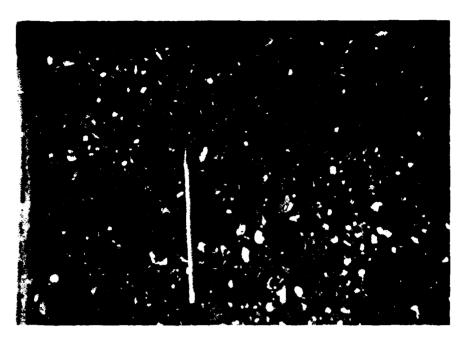
Photograph AlO. Downstream of lower gates small lock chamber middle wall



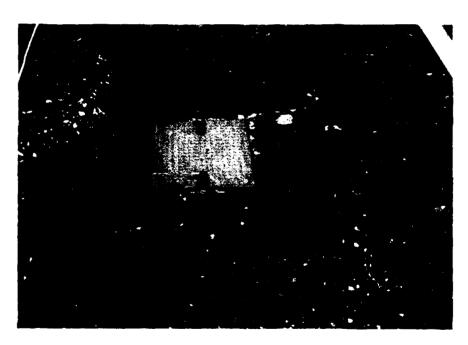
Photograph All. Lower gate recess middle wall small lock chamber



Photograph Al2. Downstream of lower gates of small lock chamber in middle wall



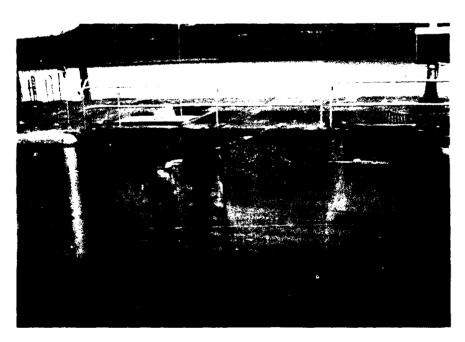
Photograph Al3. Top of upper guard wall joint between monolith No. 8 and No. 7



Photograph Al4. Top of upper guard wall monolith R-5



Photograph Al5. River side upper guard wall



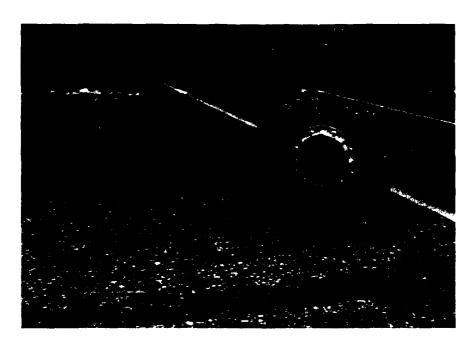
Photograph Al6. Upper gate recess river wall



Photograph A17. Cracking near gate recess monolith R-12 of river wall



Photograph Al8. Top of monolith R-13 river wall near upper gate recess



Photograph Al9. Top monolith R-15 pop out



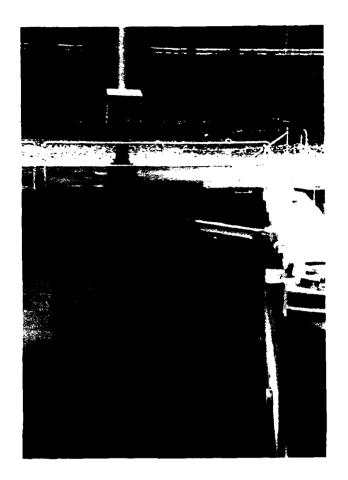
Photograph A20. Top monolith R-16 dissolution of aggregate



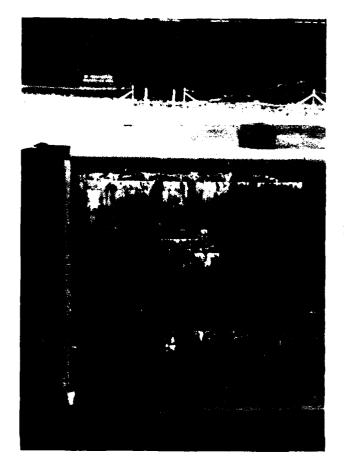
Photograph A21.



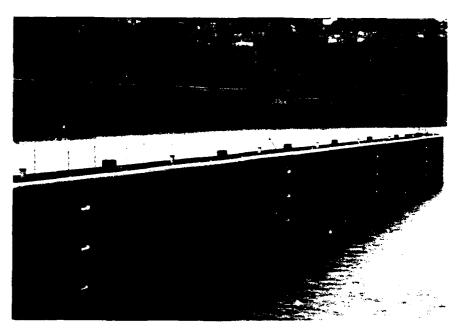
Photograph A22. River wall monolith R-23. Cracking and repairs of concrete in lower gate recess



Photograph A23. River wall lower gate recess



Photograph A24. River wall below lower gate



Photograph A25. Lower guard wall
A15

APPENDIX B: FIELD DRILL LOGS

Hele Ne. SHEET MATALLATION DRILLING LOG Unio River Lock & Dam #2 OF 2 SHEETS BROISET Rehab. of Lock & Dam 2. Mon. diver LOCATION (Consequences or State MSL See Remarks Longling Agency USAE-..ES 12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500 STATAL NO. OF OVER-BURDEN SAMPLES TAKEN HOLE NO. (As shown an assess setted SR VES IL TOTAL NUMBER CORE BOXES & L NAME OF ORILLER IL ELEVATION GROUND WATER Warhurst 17 Dec 85 MYERTICAL MINELINED. 17. ELEVATION TOP OF HOLE 730.51 7. THICKNESS OF OVERBURDEN ... IS, TOTAL CORE RECOVERY FOR SORING L DEPTH ORILLED INTO ROCK 0.0 10.55° in Concrete 9. TOTAL DEPTH OF HOLE (Drilling time, motor board of CLASSIFICATION OF WATERIALS ELEVATION DEPTH LEGENS 0.0 10000 Surface Condition: Run: 1 slightly weathered with light scaling, Begin: 0.0 End: 2.25 maximum exposed aggregate size is 2". D.T: 15 min. Rec: 2.05 0.0 - 10.4
Concrete: gray, predominately crushed
limestone aggregate, 100% Remarks: Pulled off 30x 1 maximum aggregate size is 3", subangular to angular, has Run entrained air, has entrapped air, many Run: 2 Degin: 2.25 Eng: 7.2 voids generally less than z" diameter & deep, some aggregate are cracked, J. I: 45 min. Rec: 5.0 Remarks: Ficked up 3.15: man made .2' from run 1, pulled oif .15' break. this run. 17.7 100% Box 2 3 5.0: man made break € 6.55: man made break. Run 2 Run: 3 Run: 3
Begin: 7.2
End: 10.55
U.T: 35 min.
aec: 3.75
Remarks: Picked up
.15' from run 2,
pulled off .15'
this run & left it Box 3 3 8.75: 1" steel. 100% in the nole @ 9.0: machine break. @ 9.4 & 9.8: 1" long 22 Box 4 void. ENG FORM 18 36 PREVIOUS EDITIONS ARE DESOLETE. Rosect Rehab. of Lock & Dam 2, Mon River (TRANSLUCERT)

В2

		10	V15104		INSTAL	LATION		note Re	SHEET 2
P" DRIL		×6   ~	in orno	Xsz		& Dat	n #2		OF 2 SHEETS
L PROJECT					10. SIZE	AND TYP	2 OF 917	b" Diamond	
Renab.	of Lo	ock &	Jam 2,	don. River	4	UN FOR E	EVATION	THOSE LIES - 10	49
See Re		er 51	#14A)		MSL 12 MAN	U# ACTUR	PARA DESI	GHATION OF ORILL	
1 ORILLIMO	AGENCY					ling 15			·
	USAE WES						OVER-	DISTURBED	UNDISTURBED
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& DIRECTIO				DEG. FROM YERT.	HL DAT	E HOLE		7 Dec 85	17 Dec 85
<b>E</b> ven•					17. ELE	VATION TO			
7. THICKNES		_						y for boning	100 =
a. DEPTH D		_	0.0			ATURE OF			1.1
9. TOTAL D	EPTH OF	HOLE	10.55	' in Concrete	<u> </u>			well ! !!	127
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							Mele Me.R	R WES L-2-	86
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			Ohio River ion or Locks & Dam No. 2	Monor	ngahela	River		OF 9 SHEET	4
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28. 2.4	U.S.	of Ma	rker pen, 30.0' in from	12 HAM	UFACTUR		GRATION OF DRILL		7
USAE W	ES				ling Ir	uck -	Mounted Rig	UNDISTURBED	┨
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& NAME OF			BR WES L-2-86	14 707	AL NUMBE	R CORE	PORES 5		7
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S. TOTAL DE	EPTH OF	HOLE	80.51	1			0. // ////	wi-	1
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NG FORM	1836	PREVIOU			Rehabi	itari	on of Locks &	HOLE NO.	
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LATION	Locke	Hele No. BR WES L- 6 Dam No. 2, SHEET 2
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Hele Ne. BR WES L-2-86 STALLATION LOCKS & UAM NO. 4. SHEET 3 DRILLING LOG Ohio River Monongahela River OF 9 SHEETS . PROJECT Rehabilitation of tocks and Dam 10. SIZE AND TYPE OF BIT 4 X 5" No. 2. Mononganela River

2. Locarion (Consumers of former) Landwall monolith 28

2.4' U.S. of marker pen. 30.3' in ir. m.rive

3. ORILLING AGENCY 1866 MSL 12. MANUFACTURER'S DESIGNATION OF DRILL FAiling Truck - Mounted Rig USAE - WES 11 TOTAL NO. OF OVER- DISTURBES BR WES L-2-86 L HAME OF DRILLER 14. TOTAL NUMBER CORE BOXES IL ELEVATION GROUND SATER Gene Warhurst STARTED IS DATE HOLE 12 Feb 86 17 Teb 86 THELINED IT. ELEVATION TOP OF HOLE 727.0 7. THICKNESS OF OVERBURDEN IS. TOTAL CORE RECOVERY FOR BORN & DEPTH DRILLED INTO ROCK 20.81 B. TOTAL DEPTH OF HOLE 80.5 CLASSIFICATION OF MATERIALS S CORE LEGEND ð 5-in. drive sample, using 300-1b hammer 25 6 Large "brick" of slag material, 3 X 4 X 6-in. Soos Pea gravel to l in. maximum. mud clayey mud. gray-brown, silty Grind to 25.0 ft. using 8-in. rock bit Silty, clayey mud, black, 2-1/2 in. splitspoon, with numerous flecks of using 300 lb hammer. steel throughout 100 7 Weight of hammer pushes sampler. No blows needed. Locks and Dam No. 2. Monongonela River ENG FORM 1836 PREVIOUS & STIONS ARE DESCLETE HOLE NO BR WES L-2-8 (TRANSLUCENT)

Hole No. 3R WES L-2-86

DRILL	ING LO	c ∣°	Ohio River	Mono	<u>ngahela</u>	River	
PROJECT	Rehat	ilita	tion of bocks and Dam	10. 312 11. DA	UN FOR F	E OF BIT	4 X 5" H SHOWN (TWW - ARL)
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8. 2.4'	U.S.	of ma	rker pen. 10.0 in Cr	Ott. 12. WA	Iling T	THE .	Mounted Riz
USAE -	w 2 3			12 701	TAL NO. OF LOEN SAMP	OVER.	CHARTANGED CHOISTONGED
			8R WES L-2-86	<b>)</b> ——	AL NUMBE		
Gene W		t	_		VATION G		ATER
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DEPTH OR					AL CORE		TOR SORING 92
TOTAL DE	PTH OF	40LE	80.5'				louce !. (lilver
LEVATION	DEPTH	LEGEND	CLASSIFICATION OF WATE	ERIALS	RECOV-	SAMPLE NG.	(Prilling time, major trees, depth of
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]	ュ	~~~~	Clayey mud, black to	dark			using 300-1b hammer, 4 blows
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Hele Ne. BR WES L-2-86 HSTALLATION LOCKS & Dam No. 2, DRILLING LOG Ohio River

1. PROJECT Renapilitation of Locks and Dam
No. 2, Mononganeia River DRILLING LOG OF 9 SHEETS Monongahela River 10. SIZE AND TYPE OF BIT 4 X 5"
11. DAYUM FOR ELEVATION SHOWN (1984 - MILL) 2 LOCATION (Commission or Similary Landwall, monolith 28, 2.4' U.S. of marker pen, 30.0' in from a DRILLING AGENCY FIVER FALE MST. Failing Truck - Mounted Rig 13. TOTAL NO. OF OVER CONTURBED BURDEN SAMPLES TAKEN! USAE WES BR WES L-2-86 14. TOTAL NUMBER CORE BOXES 5 NAME OF DRILLER IS. ELEVATION GROUND WATER Gene Warhurst ---IL DATE HOLE 12 Feb 86 17 Feb 86 THERTICAL MINCLINED IT. ELEVATION TOP OF HOLE 727.0 7. THICKNESS OF OVERBURDEN 59.7 18. TOTAL CORE RECOVERY FOR SORING 19. SIGNATURE OF INSPECTOR/ A. DEPTH DRILLED INTO ROCK 20.8 S. TOTAL OFFTH OF HOLE 80.5 S CORE CLASSIFICATION OF WATERIALS LEGEND 2-1/2 in. splitspoon, using 300-1b hammer 4 blows Clayey mud. dark gray 100 10 Grind to 45.0 ft, using 8-in. rock bit 2-1/2 in. splitspoon. using 300-1b hammer 27 blows 35 46.0⊐ 11 Very sandy, brown clayey mud with gravel to 1 in. maximum diameter on bottom Grind to 50.0 ft using 8-in. rock bit

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.

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PROJECT KENADILITATION OF HOLE NO. Locks and Dam No. 2, Monon- BR WES L-2-86 gahela River

Hele Ne. BR WES L-2-86

DRILLING LOG Onto River  1. PROJECT Rehabilitation of Locks and Dam No. 2. Monongahela River  1. Location of Constant Program of Action of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Constant Program of Consta	
No. 2. Mononganela River  L. LOCATION (Condenses or Similar) L. DOTATION (Condenses or	760
28. 2.4' U.S. or marker pen. 30:0 in line  DRILLING AGENCY TIVET 1888  USAE WES  A HOLE NO. (As shown as assume hits)  BR WES L-2-86  Is name of Driller  Gene Warthurs  Cone Warthurs  Cone Warthurs  Cone Warthurs  Cone Warthurs  Cone Warthurs  Cone Warthurs  Cone Warthurs  Cone Warthurs  Cone Warthurs  Cone Cone Cone Cone Cone Cone Cone Cone	760
DRILLING AGENCY  USAE WES  HOLE NO. (As shown as drawing fille) Set MED L-2-86  S. MANE OF DRILLER  Gene Warhursc  L. Direction of mole  Wyveryical [Inclined]  T. THICKNESS OF OVERBURDEN  S. 7.  T. THICKNESS OF OVERBURDEN  S. 7.  Failing Truck - Mounted Rig  L. TOTAL HUMBER CORE SOURS  TARTY S.  TOTAL NO. OF OVER   DISTURBED   United States    L. TOTAL HUMBER CORE SOURS  STATES  16. DATE HOLE   12 Feb 86   17 Fib 17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   17 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18   18 Fib 18	760
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USAE WES A HOLE NO. (As shown on decomp Hite) BR WES L-2-86  IL TOTAL NO. OF OVER.   DISTURBES UNDER SHAME OF DRILLER  S. NAME OF DRILLER  Gene Warthurst C. DIRECTION OF HOLE  MY VERTICAL   INCLINED  OEG. FROM VERT.  7. THICKNESS OF OVERBURDEN  SO. 7'  12. THICKNESS OF OVERBURDEN  SO. 7'  13. TOTAL NO. OF OVER   DISTURBES UNDER STARTER  LA TOTAL NUMBER CORE BOXES  14. TOTAL NUMBER CORE BOXES  15. ELEVATION GROUND WATER  16. DATE MOLE  17. FLEVATION TOP OF MOLE  727.0'	760
S. NAME OF DRILLER  Gene Warhursc  L. DIRECTION OF MOLE  WYENTICAL CINCLINES OF ORE PROMINER.  T. THICKNESS OF OVERBURDEN  SO. 7!  T. THICKNESS OF OVERBURDEN  SO. 7!  T. THICKNESS OF OVERBURDEN  SO. 7!  T. THICKNESS OF OVERBURDEN  SO. 7!	
S. NAME OF DRILLER  Gene Warthurst  L. DIRECTION OF HOLE  ET VERTICAL STATEM OF B. 12 Feb 86 17 F.  7. THICKNESS OF OVERBURDEN SO 7'	
Gene Warhurst  DIRECTION OF HOLE  STARTED  DEG. FROM VERT.  16. DATE HOLE  17. FILEVATION TOP OF HOLE  7. THICKNESS OF OVERBURDEN  SO. 7!	
E DIRECTION OF HOLE  EVERTICAL THICKNESS OF OVERBURDEN SO 7'	
7. THICKNESS OF OVERBURDEN SO 7!	1
7. THICKNESS OF OVERBURDEN SO 7'	±5 86
17. THICKNESS OF OVERBURDEN CO 71	
18. TOTAL CORE RECOVERY FOR BORING 07	
B. DEPYN DRILLED INTO ROCK 20.8"	7.
9. TOTAL DEPTH OF HOLE 80.5'	wow
ELEVATION DEPTH LEGEND CLASSIFICATION OF WATERIALS SCORE BOX OR (Ordling time, motor too.	4
ELEVATION DEPTH LEGEND CLASSIFICATION OF BATERIALS RECOVERY NO. 10 Confidence from the following times been been been been been been been be	dopth of
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Mixed gravel, pea size 2-1/2 in. splitsp	
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sandy, w/some blue-gray	⊨
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- 00000 Mixed gravel, pea size 2-1/2 in. splitsp	E
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Clayey mud. brown, sandy 80 13	F
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Sand and pea gravel, mixed	F
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Backfill-rock contact   59.7'-drill actio	1,5e- F
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NG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT KEHADILITATION OF TO BR	WES L-2-

Hele Ne.BR WES L-2-86

		104	VISION	INSTALL	ATION 1	ocke A	Dam No. 2, SHEET 7	٦ .
	ING LOC	;	Ohio River		nganel		OF 9 SHEETS	<u>↓</u>
I. PROJECT	Rehabi.	litati	on of Locks & Dam No.	10. SIZE	AND TYPE	OF SIT	4 Y 5"	4
2. Monor	ganela	River	entinediali manalish	HE BAYUM FOR ECEVATION SHOWN THE - MEL)				
28. 2.4	U.S.	of mar	ker pen_30.0 in from	MSL 12. HAMUFACTURER'S DESIGNATION OF ORILL				
& DRILLING	AGENCY	LYAGE	- Tace	Fai	ling T	ruck +	Mounted Rig	_]
USAE	WES			19. 707	AL NO. OF	OVER-	M UNDER CHOISTURGED	
A HOLE NO.	(Ae 200000 100000	-	BR WES L-2-86					4
S. HAME OF	DRILLER		<u> </u>		AL HUMBE			-
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& DIRECTIO				IL DATE	E HOLE		2 Feb 86 17 Feb 86	1
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7. THICKNES	5 OF OVE	-	59.7'				FOR BORING 92 . 1	.1
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ELEVATION			CLASSIFICATION OF MATERIA	14	1 CORE	SAMPLE NO.	APPRING THE PRINCIPLE OF THE PARTY OF	1
PERAVIOR	02-17	-	(Description)		ERY	NQ.	(Driffing time, major toon, down of processoring, also, if pignificant	1
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	l <u>−</u> i	<b>-</b>	<del> </del>	_	1	1	End: 68.20°	E
	66.0		Gray shale, soft to	ode-	ļ	1	D.T.: 1 hr 50 min	F
	→	<u> </u>	rately hard		ĺ	Box	Rec: 3.65'	F
	⇒	JL 72	İ		80	2	1	F
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ENG FORM	1836	PREVIO	US EDITIONS ARE OBSOLETE.		PROJEC	Rehab	No. 2, BR WES	
MAR 71			(TRANSLUCENT)		FOCKS	oahela	River BR WES	L-2

Hele Ne. dR WES L-2-86

Dan 1	ING 10		IVISION	INSTAL	ATION L	ocks 6	Dam No. 2.	WES L-2-8
	LING LO	I_	Ohio River	Mone	AND TYPE	a Kive	r [0	9 SHEETS
. Monor	nganei	a Rive	r	II. DAY	UN FOR E	CEVATION	SHOAM LIBE - MET)	
LOCATION	(Coorden	ates or 51	Landwall, monolith	MSI				
DRILLING	U.S.	of ma	rker pen, 30.0' in from	12. MAN	UFACTURE	ER'S DESI	GNATION OF ORICE	
USAE WE	ES				AL NO. OF DEN SAMP			-018 TVA BED
HOLE HO.	(As also		BR WES L-2-86	BUR	DEN SAMP	LES TARE	IN !	
HAME OF	DRILLER				AL HUMBE			
Gene b	Jarhur:	st		IS ELE	VATION GI			
DIRECTION .			0E6. FROM VERT.	IG. DAT	E HOLE			7 Feb 86
				17. ELE	VATION TO			
DEPTH OR							Y FOR BORING 92	
TOTAL DE			80.5'	19. SIGN	ATURE OF	INSPECT	/	110-2
					3 CORE	BOX OR	A REMARKS	CARRO
LEVATION		LEGEND	(Decorposition)	_		SAMPLE NO.	UlDritting time, major to	ros, dopth of Handisami
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	_ =		_				Run: 3	
ŀ	71.0		Gray shale, w/band of b	nwor	1		Begin: 68.2'	
ſ		==	shale. moderately hard.			_	End: 73.2'	
l	_		slightly silty, some		95	Box	D.T.:   hr 18	min
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1	$\exists$		Gray shale, moderately	hard.		Box	Run: 4	
1	7		some brown bands, sligh			4	Begin: 72.65	
Į.	75.0		silty, some calcareous	1		į	End: 77.7	
	i∃		modules		100		D.T.: 1 hr 10	min .
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1	78.0]			Į.				
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ł	7.		Gray shale, moderately	hard.	ļ	Box		
- 1	,, ,티		slightly silty	ł		5	Run: 5	
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	79.0			-	- 1	ļ .	Begin: 77.5'	
1	Ⅎ			ļ			End: 80.5'	
				ì	99	1	D.T.: 51 min	
ļ				-	-	1	Rec: 3.0'	
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	80.0							<u> </u>
G FORM	80.08		S EDITIONS ARE OBSOLETE.		PROJECT Locks	Rehab	ilitation of	HOLE NO.

		16	IVISION		1			He-	le Ne. BR	ES L-2-
DRIL	LING L	oc   `	Ohio Ri		METAL	LATION	Locks 6	DAE No.	2, SH	EET 9
PROJECT	Bahak	414600	ion of Locks a	24 00=	Mono	ngahe i	a River			9 SHEETS
No. 2.	Monore	ahela Tahela	.ion of Mocks & River	III DAE	10. 512	E AND TY	PE OF BIT	4 X 5"		
LOCATIO	H (Carre		Landwall,	monal / et	7		FFEATIO	H THOUR (THE	- MIL)	
8 2.4	U.S.	of ma	rker pen. 30 0	uonorien 'in from	- MS	1				
DAILLING	S AGENCY	LIVEL	rker pen, 30.0		1	-UFACTUR	ER'S DESI	SHATION OF	DRILL.	
SAE WE	S				Fa	11ing	Truck -	Mounted	Rig	
HOLE NO	· (Aq abou	-	me must		- 100	IDEN SAMI	PLES TAKE	CHETURBE	-	-
			BR WES	L-2-86						
	DRILLER	_					ER CORE			
ene Wa	rhurst				IF EFE	VATION G	ROUND WA	TER		
	34 OF HO						1574	ATED	COMPL	
AEB40	** 🗆	MCF-1460	DEG	FROM VERT.	TE DAT	K HOLE	12	Feb 86		Feb 86
MICK MARK	15 OF OV				17. ELE	VATION T	OP OF HO			
					_			Y FOR BORING		
EPTH D	RILLED IS	TO ROCK	20.8		19 5164	ATURE O	PINSPECT	Y FOR MONING	92	<u>`</u>
POTAL DE	EPTH OF	HOLE	80.51					IME (	'' /////	٠,٠
	DEPTH						100- 00			1/ <sub>2</sub>
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ORM 18	36 PM	EAIONT E	DITIONS ARE OBSOLE	TE.	17	OCKS A	ehabili Dam No	tation of	1 704	£ 110.
,,,	, 30 PA		DITIONS ARE OBSOLE Ranslucenti	TE.	l'i	ocks & lononga	Dam No Dam No hela Ri	tation of	BR	WES L-

		[0]	VISION	INSTALL	ATION		Hele No. 2-3
DRIL	LING LO	<u>ن.</u>	io liver		( st )4		or 2 SHEETS
enao.	ست نه	ock 5	Dam 2. mon. siver		AND TYP		L SHOAN LARK S. WITT
LOCATION	(Carrie	<b>ates</b> or 510	1/20	137	UE ACTUE	10.5 0000	GRATION OF ORILL
DRILLING			-cke	r ski	عنه ت		
HOLE HO.	(A)		ng titlet	12 101	AL HO. OF DEN SAMP	OVER-	CHERUTEION UNDISTURBED
MAME OF			ئے دی تر الد 1−3 نوب		AL HUMBE		
an la		_			VATION G		
DIRECTIO				IL DAT	E HOLE		Get 85 :24 Cet 85
T VERTE				17. ELE	VATION TO		
THICKNES							Y FOR BORING. 100 S
. TOTAL DE			13.17	19. SIGN	ATURE OF	INSPECT	
			CLASSIFICATION OF MATERIA	14.5			REMARKS
LEVATION	O. G	LEGEND	(Desergency)		RECOV-	BOX OR SAMPLE NO.	(Drilling time, water toos, depth of
		٥	Surface Condition:				Run: 1
	$\exists$	7.7	slightly weather				Begin: 0.0
ļ	=		with medium scali				End: 2.3
1		1	gregate size is				D.T: 50 min. Rec: 1.8
J	1.4	-	Surface crack wi	th	1 00%		Remarks: Pulled off
i	7	أسرجيه	slight separation	1 15			.5'.
	E	122	within 3'.				
	$\exists$	أيجيز	0.0 - 15.0				
[	2.₫	<u></u>	Joncrete: gray, po			Box 1	
		أخير	dominately crushed limestone aggregation		⊋.,, <del>.,</del> 1		
ſ	7	1.5	maximum acrregate		Run 1		
		اخ:	size is 37, pread	mın-			Run: 2
ļ	$\exists$		ately subangular, good consolidation	,			Begin: 2.3
	3.0∃	اشير	entrapped and en				End: 4.1 D.T: 35 min.
ļ	$\exists$	10	ed air, many voic	is	100%		Rec: 1.05
	⇉		generally less to				Remarks: Ficked up
	╛	أشير	z" diameter & dec some cracked aggr				.ĵ' from run 1, culleu off .35'
ļ	=	<b>*</b>	gate,	-			this run.
1	4.07	10	-	į	Run 2	·	,
1	3	-/-					dune 3
							dun: 5 Degin: 4.1
ł	⇉						ina: 0.2
}	5.0∃	~[]					D.7: 50 min.
[	~~~			Į	100%		Rec: 2.25
ł	3	(-)		ĺ			.35' from run 2,
ł	$\exists$	【4】				Box 2	pulled off .2'
{	$\exists$	-:/]		ļ			this run.
- 1	6.0∃				ا ا		
ł	⇉			Į	Run 3		
i	⇒.			Ì		1	Run: 4
ł	7		a 6 66				Begin: 6.2
ľ	={\dagger{2}}	201	9 6.65: manmade i	геак	•		End: 11.2
ľ	7.9크	150					D.T: 5 hrs 30 min.
1	$\exists$	201	₹ 7.3: manmade bi	eak.			Remarks: Ficked up
- 1	E	一派		1			.2' irom run 5,
1	⇉	1/2		- 1	100%		pulled off .3' this run.
1	E.o.	10.					onto lun.
l'	~~~	(-1		1			
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j	7	ات		ł	- 1		ŀ
}	7	1.		]			į į
	9.0 Ŧ·	المئير		l		Box 3	ļ
ļ	7	$ \mathcal{L}_{0} $		ļ	ļ		
- 1	∃	$\Sigma \mathbb{Z}$	⊋ 9.4: manmade bi	eek			
	<u> </u>	77					
1	3	345		}			
	<del>_</del>						
G FORM	10 14		EDITIONS ARE ORSOLETE.		PROJECT		o. of Lock & HOLE NO.

STEET 2 INSTALLATION DRILLING LOG Chio River Look & Dam #2 OF 2 SHEETS . PROJECT IG. SIZE AND TYPE OF BIT 6" Diamond Bit Rehab. of Lock & Dam 2. Mon. River See Remarks 12. MANUFACTURER'S DESIGNATION OF ORIL Acker Skid Rig USAE WES 13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN HOLE NO. (As shown an drawing title) 0 14. TOTAL NUMBER CORE BOXES S HAME OF DRILLER 18. ELEVATION GROUND WATER Dan Taylor -IS DATE HOLE 21 Oct 85 24 Oct 85 TYERTICAL MINELINED 17. ELEVATION TOP OF HOLE 732.5 7. THICKNESS OF OVERBURDEN 0.0 18. TOTAL CORE RECOVERY FOR BORING 100 0.0 19. SIGNATURE OF INSPECTOR S. DEPTH DRILLED INTO ROCK S. TOTAL DEPTH OF HOLE 16.1' RECOV- SAMPLE REMARKS
(Drilling case, succer tone, death of presidents), six., if significants CLASSIFICATION OF WATERIALS DEPTH LEGENS ELEVATION 10.0 Run 4 Run: 5 Aun: 5 Begin: 11.2 End: 15.1 D.2: 1 hr 40 min. Gec: 5.1 Remarks: Ficked up .3' from run 4, pulled off .1' this 3 11.45: low angle crack. Zox 4 run. Drill action was @ 12.95: manmade smooth throughout break. toring. 100% of water was retained. Pund Night 100% 3 13.7: 13" long ABBRIVIATIONS: void. \$ 14.0: 1" long D.T: drill time Rec: recovery E.O.B: end of borvoid. 14.15: manmade ing. oreak. BOXES: Box 5 0.0 - 3.75 3.75 - 7.3 7.3 - 10.9 10.9 - 14.15 14.15 - 16.0 1. 16.0 LOCATION: Run 5 E.O.B. & 16.11 Large Chamber îlow -431 91. mono. 33 mono. 3 Landwall/ ENG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE. Renab of Lock & Dam 2, Mon. River BR WES L-3 (TRANSLUCENT)

SHEET HSTALLATION DRILLING LOG <u>Lock i Dam #2</u> chio diver OF 1 SHEETS 10. SIZE AND TYPE OF BIT OF ATTOMOS PROJECT Rehab. of Lock & Dam 2, Hon. River L LOCATION (Come 12. MANUFACTURER'S GENGMATION OF DRILL
12. MANUFACTURER'S GENGMATION OF DRILL
12. TOTAL NO. OF OVERSUNDER SAMPLES TAKEN
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15. TOTAL NO. OF OVERSUNDER SAMPLES TAKEN
15. TOTAL NO. OF OVERSUNDER SA See Genarks USAZ = .723 L HOLE NO. (As sharm on drawing little) .37. .725 16. TOTAL HUMBER CORE SOXES 1 NAME OF DRILLER IS ELEVATION GROUND WATER Dan Tavlor-21 Cat C5 71 Cat 35 pee From vent 18. DATE HOLE TYERTICAL TINCLINED 17. ELEVATION TOP OF HOLE 7. THICKNESS OF OVERBURDEN .) . C 18. TOTAL CORE RECOVERY FOR BORING 19. SIGNATURE OF INSPECTOR A. DEPTH DRILLED INTO ROCK U.O S. TOTAL DEPTH OF HOLE 1.21 in Concrete REMARKS!
(Drilling time, mores toon, death of measuring, etc., if experienced CLASSIFICATION OF WATERIALS ELEVATION DEFTH LEGEND 0.2 Surface Condition: .nod-Run: 1 Segin: 0.0 erately weathered 100% End: 1.15 D.I.: 55 min. Rec: 1.05 with some exposed agg. - max. agg. size is 2". iun 1 Remarks: Fulled off 0.0 - 3.15.1'. Concrete: gray with 30x 1 darker gray agg., precominately crushed Run: 2 Begin: 1.15 limestone agg., max. agg. size is 2", pre-End: 3.2 D.T.: 1hr 10min. Rec: 2.1 agg. size is 2", pre-dominately supangular good consolidation. Remarks: Ficked up entrapped a entrained air, many voids -.1' from run 1, pulled off .05' none greater than ; this run. diameter & deep, 2.C: void is filled Run 2 100% of water was retained throughwith wood. out boring. Drill action was smooth throughout boring. 0.0.3. 1 3.21 LCCATION: Hiddle all Large Chamber - flow -→ <u>√</u>15" mono:-18'mono, 37 Landwall 38 ABBREVIATIONS: max: maximum agg: aggregate D.T: drill time Rec: recovery 2.0.B: end of boring. ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. Dam 2, Mon. River BR WES L-4

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				.IMEV A.	ATION		dole No.	od ES L-	<u>&gt;- ?</u>
DRILL	ING LC		Ohio River	Mono	ngahel	ocks a <u>a Rive</u>	uam /o	SHEET 1	TS
			tion of Locks & Dam .	10. SIZE	AND TYP	C OF BIT	4 X 5"		_
No. 2.	Monons	gahela		MSI		LEVATIO	SHOWN THE CHILD		
3. 421	in fro	om rive	er face and 12° U.S. of			ER'S DES	GHATION OF DRILL		_
USAE W	AGENCY	BORO.	lich join <u>e</u>	Fat	ling I	ruck -	Mounted Rie		
HOLE HO.	(As almos		me cicles	13. TOTAL NO. OF OVER- DISTURBED UNDISTURBED 12					
MAME OF C			BR WES L-86	14. 707	AL NUMBE	R CORE			
Gene W					VATION G				
DIRECTION	0F HOL	. C		16. DAY	E HOLE				_
T VERTIC	- O	HELIMEO		L				0 Feb 86	
THICKNESS	OF OVE	MOUNDE	N 54.9'		VATION TO			k 30	
DEPTH DAT	LLEO IN	TO ROCK	18.3'		ATURE OF			<u> </u>	<u>.</u>
TOTAL DE	PTH OF	HOLE	73.2'	<u> </u>					
LEVATION	DEPTH	LEGENO	CLASSIFICATION OF MATERIA		RECOV-	BOX OR SAMPLE NO.	(Drilling time, were weathering, etc.,	r to co. domin of	,
_•_								il signiffsont	
1	□	•	Concrete, surface intac crushed L.S. agg, maxim		100	Box	Run: 1		
ŀ	=	$\Delta$	l", concrete brown w/da	rk	100	1	Begin: 0.0' End: 0.6'		
1		70 20 10	eray bank 0.5-0.6'. En	tran-	10		D.T.: 3 min		
}	=	流	ped air voids, maximum no entrained air.	1/4 ',	10	Sample 1	Rec: 0.6'		
- 1	1.0_	<u>ڪيٽ</u>	,		<b></b>	<u> </u>	Co		
- 1	=	\ /	Clayey gravel, some sla brown, maximum	g,	l	1	Comments: wa		
1		1 /			İ		slabs		
}	$\exists$	1 //			}	]	2-1/2" splits		ed
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	2.0□	$  \cdot  $			ĺ	-			
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Hole No. 3R WES L-5-8

MONO 10. \$121 11. DAY 11. DAY 12. MAM Fai 12. YOU 14. TOY 15. ELE 17. ELE 18. TOY	INGANE IS AND TYPE IN THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROP	RIVETE OF BIT	GRATION OF DRILL  MOUNTED RIG    OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE     OSSUMBLE
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12 YOY 12 YOY 14 TOY 15 ELE 17 Y. 16 DAT 17 ELE 18 TOY 18 SIGN	AL NUMBER VATION OF  AL NUMBER VATION OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF  AL CORE OF	R CORE : ROUND W - 18 POP OF HO RECOVER : INSPECT : NO. 1 PO SAMPLE NO. 1 PO SAMPLE NO. 1	I COMPLETED  INTER  INTER  INTER  INTER  INTER  INTER  I COMPLETED  I D Feb 86  LE 730.5'  Y FOR BORING ROCK 80  TOR  I Chapting time in the internal deputy of managements, and it dispressionally and internal deputy of managements, if dispressionally and internal deputy of managements, if dispressionally and internal deputy of managements, if dispressionally and internal deputy of drive sample, using 300-1b hammer
14. TOT 18. ELE 17. 19. DAT 17. ELE 18. TOT 18. SIGN HALS	AL NUMBER VATION OF THE MOLE VATION TO AL CORE FATURE OF THE CORE FACOVERY	R CORE IN ROUND IN 18 18 18 PP OF NO NECOVER INSPECT	SORES 7  JAN 86 10 Feb 86  LE 730.5'  Y FOR SOREMARY REMARKS  (Drefting times, marrier brees, depth of considerating, set, if adjustmentally  5" drive sample, using 300-1b hammer
15. ELE 7. 16. DAT 17. ELE 19. TOT 19. SIGN BIALS	VATION OF	18 OF OF MO RECOVER INSPECT BOX OR SAMPLE NO.	TER  INTED  LE 730.5'  V FOR BORING ROCK 80  TOR  TOR  TEMBRES  TOR  TEMBRES  TOR  TEMBRES  TOR  TOR  TEMBRES  TOR  TOR  TOR  TOR  TOR  TEMBRES  TOR  TOR  TOR  TOR  TOR  TOR  TOR  TO
17. ELE 18. TOT 19. SIGN	VATION TO AL CORE I IATURE OF RECOVERY	18 OP OF HO RECOVER INSPECT	Jan 86 10 Feb 86 LE 730.51 VFOR SORNING ROCK 80  (Bygling Imm. marce bros. dopth of conditionally object, if appellationally 5" drive sample, using 300-1b hammer
17. ELE 18. TOT 19. SIGN	AL CORE I	18 DP OF HO RECOVER INSPECT	Jan 86 10 Feb 86  LE 730.5'  Y FOR BORING REMARKS  (Digling into more inco. doubt of maintenance, etc., if significance)  5" drive sample, using 300-1b hammer
17. ELE 18. TOT 19. SIGN NALS	CORE S	BOX OR SAMPLE NO.	TON BORNER REMARKS  (Dysting time, mirer inco., down of considering, occ., if significant)  5" drive sample, using 300-1b hammer
19. SIGN	COME RECOV-	BOX OR SAMPLE NO.	PFOR SORING ROCK 80  REMARKS (Digiting time, more inco., depth of standardering, otc., if eignificant)  5" drive sample, using 300-1b hammer
l. max-	T COME RECOV- ERY	BOX OR SAMPLE NO.	(Degling into, nerve from double of managering, sets, if repetitement y
1. max-	•	Sample	5" drive sample, using 300-1b hammer
1. max-	•	Sample	5" drive sample, using 300-1b hammer
ag,			300-1b hammer
ag,			300-1b hammer
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			1
		l	
			Grind to 15.0' using
	1		8" rock bit
			Bit brings up slag, 2-4
	1		in diameter and 1/2" to
			l" pieces of steel
	1		
	}	}	
	<del></del>		
_		Fame la	5" drive sample, using
	) ,0	2 A PIG	300-1b hammer
	}	-	
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	] ]		
	]		Grind to 20.0', using
	}		8" rock bit
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			llitation of Hout Ho.
•	r eter	r 50	r 50 Sample

Hele Ne. BR WES L-5-66

PROJECT Rehabilitat	Ohio River Clon or Locks & Dam	Mono!	ngahela Lamb TYP	River	4 X 5"		
On ILLING AGENCY DONO  USAF LIFE  USAF LIFE  ORILLING AGENCY DONO  USAF LIFE	River Landwall, monolith er tace, i2 U.S. of	MSL 12. MANUFACTURER'S GENGRATION OF DRILL Failing Truck - Mounted Rig					
HOLE HO. (As alson as dead	ng cutor	13. TOTAL NO. OF OVER.   DISTURBED UNDISTURBED					
Gene Warhurst	BR WES L-5-86		AL HUMBS				
DIRECTION OF HOLE	<del></del>		R HOLE		ATED  COMPLETED		
TARTICAL DIMELIMED			VATION T		Jan 86 10 Feb 86		
THICKNESS OF OVERBURDEN		18. TQT	AL CORE	RECOVER	Y FOR BORING ROCK 80		
TOTAL DEPTH OF HOLE	73.2'	19. SIGN	ATURE OF	INSPECT	TOR		
EVATION DEPTH LEGEND	CLASSIFICATION OF MATERIA (Decompletely)	us.	S CORE RECOV- ERY	SAMPLE	(Drilling time, miles look, depth of meastering, etc., if eignificant)		
					Grind out casing with 8" rock bit		
21 A	Slag, 3-4" in diameter, steel fragments to 1-1/2 diameter	2"	75	Sample S	5" drive sample, using 300-lb hammer		
23.61					Crind to 25.6", using 8" tock bit		
D. 0.000 000000000000000000000000000000	lag, 2-3" diameter, ste ragments to 1-1/2" diam	el	75	ample	5" drive sample, using 300-1b hammer		
28.0					Grind to 30.0°, using 8° rock bit		
			-	1	ļ:		
130.0 →							

Hole No. UK LES L-3-50

DIVISION	IMSTAL	LATION T	acks A	Dam No. 2, SHEET 4			
DRILLING LOG Ohio River	\ Mono	ngahela	River	OF B SHEETS			
PROJECT Rehabilitation of Locks & D. D. 2. Monongahela River	TI. DAY	E AND TYPE	EVAYION	SHOWN (THM - MEL)			
LOCATION (Communion or Station Landwall, more), 42' in from river tace, 12' U.S.	nolith MSL						
ORILLING AGENCY MOROLICIE JOINE	. OL 12. MAI	12. MANUFACTURER'S DESIGNATION OF DRILL					
USAE WES	12. 70	Failing Truck - Mounted Rig 11. TOTAL NO. OF OVER. DOSTWORD UNDESTURBED 12					
HOLE NO. (As alsown on drawing title) BR WES L-5	÷86 <del> </del>	BURDEN SAMPLES TAKEN 1 12					
HAME OF DRILLER Gene Warhurst		EVATION GI					
DIRECTION OF HOLE				ATED   COMPLETED			
TYERTICAL TINCLINED DEG. FR	10W YERT.	TE HOLE		Jan 86 10 Feb 86			
THICKNESS OF OVERBURDEN 54.9'	<u> </u>	EVATION TO					
DEPTH DRILLED INTO ROCK 18.3		HATURE OF		v FOR BORING ROCK 80			
TOTAL DEPTH OF HOLE 73.2							
EVATION GEPTH LEGEND CLASSIFICATION O	F MATERIALS	RECOV-	BOX OR SAMPLE NO.	REMARKS (Drilling time, water leas, death of weathing, etc., if significant)			
300			ĺ				
One large piece		75		5" drive sample using			
diameter, steel to 2" diameter	rragments	[	7	300-1b hammer			
k1.0-1[]]		1					
300							
<del> </del>		1					
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=\ /		1					
p2.a□ \		1					
<u>                                   </u>		1	1	Grind to 35.2' using			
<u>  3</u>   /		1	ĺ	8" rock bit			
1 3 1/1							
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33.0		1					
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1 3 // 1							
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34.0 /			Ŧ				
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7/		1					
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I ∃≅≋i				5" drive sample, using			
Silty clay, gray							
slag pieces to 2'	ish-brown,	90					
~ldlameter	ish-brown, " maximum	90	Sample 8	300-1b hammer			
36 0 = 20 = 1	ish-brown, " maximum	90					
36 a 30 2	ish-brown, " maximum	90					
36.0 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ish-brown, " maximum	90					
36.0 20 Clameter	ish-brown, " maximum	90					
36 -0 20 01 aneter	ish-brown, " maximum	90					
36 .0 37 .0 31 aneter	ish-brown, " maximum	90					
36.00 70 70 70 70 70 70 70 70 70 70 70 70 7	ish-brown, " maximum	90					
36.00	ish-brown, " maximum	90					
36.00	ish-brown, " maximum	90					
36.00 70 70 70 70 70 70 70 70 70 70 70 70 7	ish-brown, " maximum	90		300-1b hammer			
36.00 70 70 70 70 70 70 70 70 70 70 70 70 7	ish-brown, " maximum	90		300-1b hammer  Crind to 40' using 8"			
36.0.7.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2	ish-brown, " maximum	90		300-1b hammer			
36.0.7.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2	ish-brown, " maximum	90		300-1b hammer  Crind to 40' using 8"			
36.0.7.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2	ish-brown, " maximum	90		300-1b hammer  Crind to 40' using 8"			
37.01	ish-brown, " maximum	90		300-1b hammer  Crind to 40' using 8"			
37 -0-1	ish-brown, "maximum	90		300-1b hammer  Crind to 40' using 8"			
37.01	ish-brown, "maximum	90		300-1b hammer  Crind to 40' using 8"			
37.01	ish-brown, "maximum	90		300-1b hammer  Crind to 40' using 8"			
37.01	ish-brown, "maximum	90		300-1b hammer  Crind to 40' using 8"			
38.01	ish-brown, "maximum	90		300-1b hammer  Crind to 40' using 8"			
37.01	" maximum		8	300-1b hammer  Crind to 40' using 8"			

Holo No. JA ALS L-J-50

O.B.		~   61	VISION	INSTAL	ATION	OCKS &	Jam No. 4, SHEET 5	7		
	LING LO		Ohio River		AND TYP			4		
No 2	Kena	DITIES	Diver	11. DAY	UM FOR E	LEVATION	SHOWN (TEM - MELL)	1		
LOCATION	(Comes	4160 et 31	Landwall, Egnolich	MSL				1		
43, 42	In II	OM TIV	River  Landwall, Zonolith  cr tace, 12 U.S. of	12. MANUFACTURER'S DESIGNATION OF DRILL						
	USAE W	ES		Failing Truck - Mounted Rig.  13. TOTAL NO OF OVER. CISTURGED UNDESTURBED BURDEN SAMPLES TAKEN 1 12						
A HOLE NO.	(As area			BURDEN SAMPLES TAKEN 1 2						
S. HAME OF	<del></del>		BR WES L-3-86	14. TOTAL HUNGER CORE BOXES						
	ne War			IL ELE	VATION G			7		
& DIRECTIO	N OF HOL			IS DAT	F HOLE		ATED   COMPLETED	7		
	er 🗆	WEL. WED	DES. FROM VERT.	<b>!</b>			lan 86 10 Feb 86	4		
7. THICKHES	15 OF OV	ERBURDE	N 54.9'		VATION TO			4		
6. DEPTH DI	-	170 ROCK			ATURE OF		y FOR BORING ROCK 80 s	-{		
S. YOTAL DI	-	HOLE	73.2'					1		
ELEVATION	OFFTH	LEGENO	CLASSIFICATION OF MATERIA	4.5	S CORE	SAMPLE	REMARKS (Drilling care, water lase, down at	7		
			(Descriptions		EAV	10.	Postering of a. Il significant	1		
		~=			1	i -	· · · · · · · · · · · · · · · · · · ·	#=		
	=	- C			١,,	L :	3 1/2 /- 1/2			
		~22~	Clay, s.s. gravel to l-	-1/2".	13	1	2-1/2 in. splitspoon using 300-1b hammer	上		
	=	200	small slag pieces, to be maximum	. /	ļ	9	dsing joo-ip name			
	l =	2020 2020 2020			[	ļ		E		
	1.0	~D~C			1		]	上		
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	42.0	.\/!				į '		E		
	_	X			i		3 0 55 0 75	E		
		/\				1	Grind to 43.0-ft using 8-in. rock bit	E		
		/ \					s-tu. tock bit	F		
		/ \						F		
	43.0	• ~ •				·		F		
	=	· 6 7		,				F		
		ه مده	Brown clay, mixed grave pea size to i-1/2", s.s	1,	75	Sample 10	2-1/2" drive sample	F		
			some crushed	• • •		10	using 300-1b hammer	=		
		5.7. 2.6.	5020 21451124		1			=		
	44.0	2 × 5.						E		
	=	~~~		,		· '				
i		~ ~ ~				1	1	E		
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	=	1 /						E		
	ته. ۵۶	1 //						上		
		(1 - I)				(		上		
	7	11/11	i					E		
	7		ii			1		F		
	ㅋ	1//				ļ	Grind to 48.5-ft using	E		
	46.0	. \		1			8" rock bit	E		
	=	-1/						E		
	7	. / /						E		
	7							E		
	=	/\					l	E		
	لـــــــــــــــــــــــــــــــــــــ	-/\-						E		
	⇉	AAB						E		
}	7	$I \setminus I$						E		
	コ	$I \cup I$						E		
	=======================================	1 11						F		
	لتد.84				İ			F		
}	7			ĺ		j l		F		
Į		/ N		Ì		[ ,		F		
		-						F		
	= =	ارسن	D	1				F		
ļ	49.0		Pea gravel, siliceous, p fall-in. One large piec		50	Sample 11		F		
	コ	•••	sandstone	01		''		F		
	⇉	• • , • !	<del>-</del>			-		F		
}	-	• , ,				'		F		
	⇉	:0:						F		
	50.0	0 0	<u> </u>			L		F		
NG FORM	1836	PREVIOU	S EDITIONS ARE OBSOLETE		PROJECT	Kenaba	illation of House Ho.			
			(T) AND TOTAL		LUCKS 6	, υaπa N	io. 2. Monon- BR WES L-	-5-8		

Hole No. JA nES began

DRILL	ING LO	s  °	Ohio River		ganela		0.0	8 SHEETS	
			tion of Lucks & Dam	10. SIZE AND TYPE OF BIT 4 X 5"					
lo. 2, 5	lononga	hela		MSL					
3. 42	in fro	A FLV	tandwall, monolith riace, 12 U.S. or		FACTURE	ER'S DESI	GHATION OF DRILL		
DRILLING	SAE WE	TOUGI.	ica joint				Mounted Rig	O STURBER	
HOLE NO.	(As also			IL TOTA	EN SAMP	OVER. LES TAKE	IN 1 12	DISTURBED	
			BR WES L-5-86	14. TOTA	-	R CORE	POSES 7		
. NAME OF	omillen 12 Wath	urst			ATION G				
DIRECTIO			-	IL DATE	I HOLE		ATED   CO.		
-	EAL	4C L IN E C						Feb 86	
THICKNES	S OF OVE	RBURGE			ATION TO			80	
-	ILLED IN		18.3		TURE OF		v FOR BORING ROCK		
TOTAL DE	PTH OF 1	OLE	73.2'				·		
LEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIAL		S CORE	SAMPLE NO.	(Drilling time, marer for	m. dopth of	
		e			ENY	NO.	**************************************	gailteami	
						Ī			
	⇉					1	]		
1	ュ	\ /				l			
	コ	1 /	}	1					
	Ⅎ	1/		1		1	Grind to 53.5'	sing	
1	51.0	11		ļ			8" rock bit	-	
Ì	コ	$\backslash I$		I			İ		
ì	コ	$\backslash I$		ŀ		1			
!	=======================================	V		ĺ		<u> </u>			
ļ	$\exists$	Y		ł		1			
ļ	52.0	٨		}					
- 1		/\		j		l			
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	=	11							
l	コ	$I \setminus I$		ı					
İ	$\exists$	$I \setminus V$		1					
ļ	53.0□	/ \		1					
	Π,	' \							
ļ	⇉	l		- 1					
- 1	<del></del>	≂∹≂		ŀ					
- 1	∃.	~0	61	(	0.5		2 1/20 4-4	1_	
}	54.0	ō≈ື	Clavey mud, brownish-gra		85	l2	2-1/2" drive samusing 300-1b ham		
İ		~ <u>`</u> o.	w/sand and s.s. gravel ( maximum 1" diameter			12	raying ⊃on—to yai	mic I	
1	7	~~⊙	MAXIMUM I GIAMETER	1		l i			
1	⇉	~:~~		İ	i				
İ	⇉.	اند ج		i					
1	∃:	~ <u>∽</u>		ı					
	55.0		Clayey shale, greenish-b	olue,			Run: 2		
	7		soft				Begin: 55.0'		
į	7	5	Rubble-gray shale w/iron				End: 57.0'		
1			staining, moderately has	rd,			D.T.: 33 min		
1		753	friable	1			Rec: 1.4'		
	., √∓:		-	- 1	80				
	56-0-	احتر	Gray shale, moderately	nard.					
ļ	ゴ		breaks at 20° angle alor						
- 1			iron-stained bands.	"					
!	∃:	===	¬	1					
ĺ	$\exists$	7	cored over	- 1		Box			
ļ	57.0			ŀ		2			
1	ユ		_				B 3		
	⊒ <sup>3</sup>		Iron-stained crumbly, by	roken			Run: 3		
}	-		up, brown shale	1			Begin: 56.4' End: 58.5'		
ł	∃:		Healed verticle joint	- 1			D.T.: 25 min		
	58.03		•	1	80		Rac: 2.0*		
ŀ	~~ <del>~</del>			- 1					
1	4.	-=E	Vertical joint, open, ho	ori-					
1		أتلت	zontal crack, open	1			Run: 4		
l	7	54		ľ			Begin: 58.4'		
[	#			Ī			End: 59.5'		
1	59.07	477	Shale, blue-gray, soft,	ľ	80	;	D.T.: 54 min		
İ		الهزلم	clayey	ļ	i		Rec: 1.4'		
- 1	7	4	Vertical joint-all rubbl	Le					
j	$\vec{-}$	الأك	•	Ļ					
1		$X^{\prime}$		1		)			
		_ ~ .		- 1					
j	السوم مء								
	60.0-		S EDITIONS ARE OBSOLETE.		PROJECT	0 -	ilitation of	HOLE NO.	

Hele Ne. 3R WES L-5-86

	LING LO	G	Ohio River	Monor	ngahela	River	
No. 2. !			tion of Locks & Dam River				H SHOWN (798 - 142)
LOCATION	Come	dee er 31.	er tace, 12 U.S. of	MSL			SHATION OF ORILL
LORILLING	AGENCY	#OUG.	ich joine				Mounted Rig
L HOLE NO.	JSAE WE	:S		13. 707	AL NO OF	OVER-	
Me			BR WES L-5-86		AL HUMBE		
NAME OF	ne Wart				VATION G		
- BIRECTIO				IS DAY	E HOLE		
- YERT	CAL []	#C L I # E C	DES. FROM VERT.				Jan 86 10 Feb 86
. THICKNES	S OF OVE	RBURDE	н 54.9'		VATION TO	_	V FOR BORING ROCK 80
. DEFTH DE					ATURE OF		
. TOTAL DI	EPTH OF	HOLE	73.2'		1		
ELEVATION	DEFTH	LEGEND	CLASSIFICATION OF WATERIA	LS.	RECOV-	SAMPLE NO.	REMARKS (Drilling time, weter look, dogsth of meastering, etc., if eightisens)
	-	744	Shale, blue-gray, soft,	ver-	80	Бох	Run: 5
	E	MX	tical joint-open			3	Begin: 59.5'
-		7			<del></del>	ł	End: 61.0'
	=	722				1	D.T.: 1 hr 8 min Rec: 1.0'
	61.07	۲٦	Rubble				
	7	20			80	1	
	=	מפת	Calcareous nodules				Run: 6
	1	$\sqrt{x}$					Begin: 60.5'   End: 62.5'
	$\exists$	$\mathcal{Y}^{V}$	Rubble		1		D.T.: 59 min
i	62.0						Rec: 1.7'
ì	7	$\overline{Z}$				<del></del>	
		$\langle \cdot \rangle$					
	E	$\Delta$					Run: 7
}	63.0		Rubble		80		Begin: 62.2'
	<b>=</b>	77	NADO16			Box	End: 63.75'
		$\Omega$				4	D.T.: 1 hr 1 min Rec: 1.1'
- 1	===	YN				ĺ '	
	7	<del>- } </del>					
	64.0	$\mathcal{Y}_{\mathcal{I}}$				Ì	Run: 8
	Ε	$\mathcal{T}$					Begin: 63.75
	$\exists$	$\mathcal{H}$					End: 65.80
i i	寸	$\sim$	Brown-stained area, cal-		80		D.T.: 39 min Rec: 1.58*
	٦, ٦	000	reous nodules, healed he zontal fractures	ori-	1		
- 1	65.0	{	zontal fractures				
1	$\equiv$	0	-				
ł		$\prec \Pi$					Run: 9
1	=		Blue-gray shale, soft to	,			Begin: 65.33
Į,	66.0		moderately hard, numerou	15			End: 66.91
1	7		healed horizontal fracti brown staining and calca		80		D.T.: 51 min Rec: 1.58'
j	7		reous inclusions	-			· ==
}		5	ļ				
-	3	2=-				Box	Run: 10
ľ	67.0	-	<b>-</b>		80		Begin: 66.91
1	=1	#	Shale, brown, moderately	,			nd: 67.41
ł		トジ	hard				P.T. 25 min Rec: 0.49'
ļ	7	<b>4</b> 24	Rubble				Q.47
ļ	68.83						
ľ	Ψ.				80	•	Run:
ļ	<u> </u>						Begin: 67.41' End: 70.0'
ł	<u>-</u>		Shale, blue-gray, modera	tely			D.T.: 53 min
]	_ ‡	==	hard -				Rec: 1.39'
Į,	69.0	$\lambda \zeta \lambda$	Brown shale, rubble	1			
1	ヸ	<u> </u>		1			
}	7	===3	caan abala				
l	7		Gray shale, soft to mode utely hard	r-	80		
]	70.0 <sup>]</sup>		array maru			_	
					PROJECT	Renant	Listation of HOLE NO.
MAR 71	1030	REVIOU	S EDITIONS ARE DESOLETE	i	Locks	6 Dam River	No. 2. Monon-

Hole No. BR WES L-5-8

) DIII	LINCLO		IVISION	. 24		INSTAL	LATION	ocks &		ET 8	
	LING LO		Ohio ation o	River		Monor	ngahela	River	109	8 SHEETS	
No. 2.	Monone	ahela	River			10. SIZE AND TYPE OF BIT Y V CIT					
LOCATIO	H (Camer	## 00 of 5	ieies Lat	idwail.	monolith U.S. of	MSL 12. MANUFACTURER'S DESIGNATION OF ORILL					
43. 42	in tr	OB TI	rer race	ine =	0.3. 01	•			-		
	USAE W	ES		_		Failing Truck - Mounted Rig					
HOLE NO.	(A e et e e	~ ~~	title i	BD LICE	L-5-86	SURGEN SAMPLES TAKEN 12					
NAME OF	DRILLES		<u>_</u>	DK WC3	2-3-60		AL HUWGE				
	ne War					15. ELE	VATION G				
DIRECTIO			_			IS. DAT	E HOLE		1- 04 10 F		
		MCCINE	°	0×	6. PROM VERT.	12 ELE	VATION TO			eh 86	
THICKNES	15 OF OV	ROURD	EN	54.9'					Y FOR BORINGROCK 80		
DEPTH OF	HLLED IF	TO ROC	K	18.3'			ATURE OF				
. TOTAL DI	EPTH OF	HOLE		73.2'		<u>.                                    </u>		,			
LEVATION.		LEGEN	Cr.	ASSIFICATI (De	ON OF WATERIA	<b>ال</b>		SAMPLE NO.	REMARKS (Draing than, water took weathering, etc., if etc.	. dopth of	
	-	Ż	Brown	6 gray	rubble		<u> </u>	6	Run: 12		
	=		Gray	shale					Begin: 68.8' End: 70.4'	j	
	=	74	Brown	shale.	rubble		ļ.		D.T.: 49 min	1	
	=	$\Rightarrow$	╡					1	Rec: 1.6'	ł	
	71.0		Grav :	shale.	soft to mod	ier-	80			)	
i	=		ately				1			ŀ	
i			7				1		Run: 13		
	=		Brown	shale.	rubble, mo	ttled	L		Begin: 70.4'	i	
	=		with 8				{	Box 7	End: 71.7'		
	72.0	5	d				1	'	D.T.: 40 min		
ļ		X	Ž.				<b>İ</b>		Rec: 1.3'	- 1	
			]				80			i	
	==		Grav s	hale.	soft to mod	er-	30	) 1		l	
	=	=	acely		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						
	73.0								Run: 14		
	=		1						Begin: 71.7'	í	
	l ∃		İ					i i	End: 73.2'		
			ì						D.T.: 45 min	F	
į	$\exists$		ļ				l l		Rec: 1.5'		
i											
1	$\exists$		Ì				Ì	]		i	
	$\exists$										
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FORM	1836	PREVIO	18 EDITION	5 ARE 001	OLETE.		PROJECT	Rehabi		OLE NO.	
IG FORM	1836	PREVIO	S EDITION		IOLETE.	7	PROJECT Locks & Janela	Dana N		WES	

B23

						note Ne		_
Dell		IVISION		LATION 2 Da:	<b>.</b> 35		F 1 SHEETS	1
1. PROJECT		hio diver		AND TYP			- 346618	1
		2 Dam 2, Mon. River				SHOWN (THE - HELL)	··	1
1 LOCATIO	M (Courdingles or Je	aties				-		Į.
See 34	emarks		12. MAN			GNATION OF DRILL		1
I DRILLING	AGENCY		V01-	11, 3	strea	~ 100, 110 VC	) I T	4
4 HOLE HO	· (As alson on draw	imer BR 423 2-6	13. TOT	AL NO. OF DEN SAMP	OVER-	DISTURGED   UP	-0157UR 6ED	1
		3R 425 1-6	<u> </u>	AL HUMBE		<del></del>		1
S. NAME OF				VATION G				1
Dan Ta						. / G	LETED	1
	ICAL   INCLINE	norizon tal	16. DAT	E HOLE			C 5 5	1
<u> </u>						LE -25 -1		1
	SS OF OVERBURDE					Y FOR SORING	130 \$	1
S. DEPTH D	RILLED INTO ROCI			ATURE OF	INSPECT	OR		1
9. TOTAL D	EPTH OF HOLE	1,550 in language de	ļ		1111	1.71		]
ELEVATION		CLASSIFICATION OF MATERIA	4	S CORE	SAMPLE	(Dellar Inn	oo. dogsh of	i
	0.3	(Decarping)		EAY	NO.	(Drilling time, more to mattering, etc., if a	(Aretteans)	l
	- 2//			<u> </u>				ᆫ
	1 -	Juriace Condition:		!		Aun: 1		F
		moderately weath		100%	1	Degin: 0.0		F
1		with exposed agg	. – . 211	""	l .	Ind: 1.15   J.T.: 40 mi	n	⊨
Į.		Few cracks with				Rec: 1.15		F
1	1.07	Silent separation	n ara	3		Remarks: -		上
1	1	nearpy.		111111	1			E
		· .		1	Lox I	Rum: 2		F
]	」コジ、	3.3 - 2.55		]		regin: 1.15		F
i	] 7. 5	Commete: gray, processing comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comments of the comm		1	1	End: 2.55		F
}	2.3= -	limestone agg		130%		5.1.: 1 hr	20 min	F
ĺ		agg. size is 54,			ļ į	Rec: 1,41	,,	
l	ゴン、	dominately suban		\$		Remarks: Dri		Е
	1。 3月 海	good consolidatio		Run Z		tion was smo		F
}	2.74	entrapped air, e	1-	\- <del></del>		100% of wate		F
	🗆	trained air, many		ļ		retained.	1 463	E
		voids - none gre	ter			re barner.		L
1	1 3	than ;" diameter				ABBREVIATION	s:	F
	1 7	deen, some agg. a	ire	\	1	avg: aggrega		F
		cracked.				sax: maximum		ㄷ
	1 =	l				D.T.: drill	time .	E
	=	Z.C.B. 2.551				Rec: recover		E
	\ <del>-</del> ∃	1 2.0.2 2.57	'	·	\	. 2.0.3.: end	of	F
	1 7			<b>!</b>	ı İ	Joring.		F
						-001		ᆮ
						LOCATION:		$\vdash$
	1 =							F
	-			1		Large Chami	per	F
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	7				}	~*′ —— 1	flow →	E
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ENG FORM	10.74			PROJECT			HOLE NO.	ㄷ
MAR 71	10 JO PREVIOU	S EDITIONS ARE DESCLETE	i		Rehab Mon.	. of Lock &	RP UPC 1	

				Hele Ne. 17-7
	Chio Aiver	LOCK &		SHEET SHEETS
PROJECT of Lock &	Dam 2, Mon. River			To Diamond bit
LOCATION (Communes or S		HSL		-
DRILLING AGENCY		Pailing		SIGNATION OF DRILL
HOLE NO. (As shown on de	end title 1	IS TOTAL NO.	OF OVER-	OPENUTATION CONTROL OF INST
NAME OF DRILLER	ER 'MES L-7	IL TOTAL NU		
DIRECTION OF HOLE		IS ELEVATION		TATER n/a
TYERTICAL   INCLINE	DEC. FROM VERT.	IL DATE HOL	1 2	6 NOV 35 2 DEC 85
THICKNESS OF OVERBURD				OLE 730,51
TOTAL DEPTH OF HOLE	v.5' into Concrete	19. SIGNATURE		
EVATION DEPTH LEGENS	T	3 CO	SAMPLI	REMARKS [Drilling time, never look, depth of
• 0.0		EAT	MO.	Tontonid, etc., it eleviteers
	Surface Jonaition: slightly weather	ea		RUN: 1
	with light scal-	-	1	Segin: 0.0
	ing. Exposed as:		_	D.T: 20 min.
1.630	than 5".		20X	Rec: 2.15
1 +05	0.0 - 0.5	100	%	hole without pull-
	Concrete: gray, p			ing core on 27 Nov
]->\	dominately crush limestone aggress			85. On 2 Dec 85 pulled run 1, 2.15'
2.0	maximum aggregati	e	1	Fulled off .1'.
	Size is 5", supar		1	Run: 2
	lar to angular, consolidation, en	5004	$\dashv$	Segin: 2.25
	trapped a entrain	neu	İ	End: 4.35
	air, some aggrega		-	D.T: 20 min. Rec: 2.2
3.07 (7)	are cracked, scared voids - none	c ser-	ļ	Remarks: Picked up
	larger than to de		13	1.1' from run 1.
	diameter unless	11 .	3ox 2	
		100	'1	j
4.0F/2 ×		1	-	}
	1	Run	2	
		1,111	-	1
1 72			1	Run: 3  Begin: 4.35
				End: 6.5
5.0		ļ	}	D.T: 2 hrs.
1 750	:	100	<b>ა</b>	Rec: 2.15  Remarks: Water loss
1 - Tar 3	5.4 - 6.5: encour	ter-		beginning @ 5.5':
1 39. 7	5" pipe(i.d.) wi	Lth	Box 3	encountered drain
6.0 <u>∃</u> 0/	3/8" steel wall.	.		pipe(steel walled)
= / \		1	[	
6.5	DOB 3 ( 5:	Run	3	BOXES:
T E I	E.O.B. & 6.5'			1. 0.0 = 2.15 2. 2.15 = 4.35
‡				3. 4.35 - 6.5
		ĺ	ĺ	Note: Hole abandoned
milmilmilmi				å relocated 2.5'
				downstream, see
#				hole L-7A.
			1	LOCATION:
		]	ļ	
				Large Chamber flow
		ł	1	rionolith 49
1				
			ĺ	21'
		}	1	21.2
				<u> </u>
				1
f0711	S COITIONS ARE OBSOLETE.			D OT LOCK &   HOLE NO.

BR WES L-7A

INSTALLATION SHEET OF 12 SHEETS DRILLING LOG Chin River 200k 1 73m #2 18. SIZE AND TYPE OF SIT 5" Diamond Bit Rohab of MSL See Remarks Failing 1500 USAE WES
HOLE NO. (As shame an drawing title) 13. TOTAL NO. OF OVER- CHATURGED BURDEN SAMPLES TAKEN! 0 3<u>3 738</u> IL TOTAL HUMBER CORE BOXES & HAME OF DRILLER IS ELEVATION GROUND WATER Warhurst STARTED COMPLETED 1 3 Dec 85 TVERTICAL MINCLINEO\_ 17. ELEVATION TOP OF HOLE 730.5" 7. THICKNESS OF OWNERWHEEK 58.9 Concrete 18. TOTAL CORE RECOVERY FOR BORING ROCK 98 8. DEPTH DRILLED INTO ROCK 60.6" 19. SIGNATURE OF INSPECTOR 119.5 REMARKS
(Drilling time, motor loca, dopth of machining, etc., if significant) CLASSIFICATION OF MATERIALS ELEVATION DEPTH LEGEND ا ٥د ١٥ Run: 4 Run: 4 Begin: 9.2 End: 14.2 D.T: 25 min. Rec: 5.05 Remarks: Ficked up `.\ **-**-100% .35' from run 3. 3 11.35; man made oreak. Box 5 9 13.1: man made break during retrieval. Run 4 Run: 5 Begin: 14.2 End: 19.2 D.7: 20 min. Rec: 4.75 G 15.2: man made Box 6 break. Remarks: Fulled off .25'. 100% 3 17.85: man made break. 3 18.35: man made break. 3ox 7 Run 5 ENG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT Rehab. of Lock & Dam 2, Mon. River (TRANSLUCENT) BR WES L-7A

Hele Ne. 3-71

DRILLING LOG	nio River	TACE 2 TO	<del>m</del> 2	SHEET 7 OF 12SHEETS
ROJECT		IO. SIZE AND TY	T OF BIT	5" Diamond Bit
ehab. of Lock &	Dam 3, Mon. River	MSL	CETATION	
LEE REMATKS	<del></del>	12. MANUFACTUR		GHATION OF DRILL
ISAE WES		Failing 150	OVER-	
IOLE NO. (As shown an electric	. 33 JES C-74			<u> </u>
IAME OF DRILLER		IS ELEVATION		
Warhurst DIRECTION OF HOLE				ATED   COMPLETED
ZVERTICAL [ INCLINED.	0E6. PROM VERT.	IS DATE HOLE		3 Dec 85
HICKNESS OF ENGINEERIN	58.9' Concrete	17. ELEVATION T		
DEPTH ORILLED INTO ROCK	60.6'	19. SIGNATURE O	P INSPECT	Y FOR BORING DOCK 08 5
TOTAL DEPTH OF HOLE	119.5'			
EVATION DEPTH LEGEND	CLASSIFICATION OF MATERIA	A RECOV	SAMPLE NO.	REMARKS (Detting time, major inco, dopin of measuring, etc., if eignificant)
ا ،   ١٥٠٥	<u> </u>		17	
		Į.		Run: 6
1 74	9 20.4: man ma	1e		Begin: 19.2
1 3	break.			End: 24.1 D.T: 25 min.
19. 司公公				D.2: 25 min. Rec: 4.7
21.21.22	3 21.05: man m	iae	<b></b>	Remarks: Ficked up
1 120	break.			.25' from run 5,
1 -12-6		100%		pulled off .45' this run.
1 72 0				tilla luii.
22.7.4		-		
I BAS			∃ox â	
		1		
- 1 <del>- 1</del> 스킨				
120		}	1 1	1
23.0		1	1 1	
		1	]	
1 3%		İ	1 1	
		j	<b> </b>	
24.0				
		Run d	4 )	
IXAE				
		ĺ		Run: 7 Begin: 24.1
1 124	<b>3</b> 24.75: man ma	ade	] [	End: 28.7
25.0-14.	break.	ļ		D.T: 25 min.
		l		Rec: 4.9 Remarks: Picked up
1 327		1	Box 9	45' from run 6,
I FALI		ŀ	i i	pulled off .15'
26.0 41		1	1 1	this run.
		100%		
1 774			1 1	
		ļ	1 1	
N. AE				
27.01				
1 724	9 27.25: man ma	ade	L	
	break.	l		
1 742			1 1	
28.32			1 1	
[\f`\\ <del>``\</del> \\		-		
			.	
		Run 7	1 POX	
10.日本			10	
			}	
	1) 70 7		i	
	9 29.7: man mad	16		
FORM 1836 PREVIOUS	break.			
FORM 1836 PREVIOUS		PROJECT		b. of Lock &   HOLE NO.

Code 5 Dam 2 SHEET 4 DRILLING LOG Cato diver OF12 SHEETS 10. SIZE AND TYPE OF SIT 5" Diamond PROJECT Renap. of Lock & Dam 2. Mon. River MSL 12. HANUFACTURER'S DESIGNATION OF DRILL LOCATION (Com See Remarks
ONILLING AGENCY
USAE WES Failing 1500 13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN HOLE HO. (A. ---53 733 14. TOTAL HUMBER CORE BOXES HAME OF DAILLES IS. ELEVATION GROUND BATER Warhurst L DIRECTION OF HOLE IS SATE HOLE 3 Dec 85 TOVERTICAL INCLINED 17, ELEVATION TOP OF HOLE 730.5 THICKNESS OF OVERSURDEN 58.9' Concrete 18. TOTAL CORE RECOVERY FOR BORING ROCK 98 S. DEPTH DRILLES INTO ROCK 50.61 S. TOTAL BEPTH OF HOLE 119.5 RECOV- SAMPLE CLASSIFICATION OF WATERIALS (Drilling runs, water loss readhering, etc., if etc DEPTH LEGEND 3010 Run: 3 Segin: 28.7 33.5 25 min. Ina: 2 30.9: man made 4.65 dec: Remarks: Ficked up .15' from run 7, pulled off .3' this preak. χοĖ ⊌ 31.0: тап таце 100% oread. run. ..un é Run: 9 Regin: 33.5 End: 38.3 D.T: 25 min. Rec: 4.85 Remarks: Picked up .3' from run 8, pulled off .25' 30x 100% this run. € 35.6: man made break. 36.e € 36.5: man made break. 37<u>.</u> € 37.55: man made break retrieving core from the Зох barrel. 39.5 - 56.9: aggre-Run 🛊 gate oecomes siliceous with some carbonates, rounded to subrounded, scatter ed voids generally less than to. PROJECT Rehab, of Lock & Dam 2, Mon. River ENG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE. BR WES L-7A (TRANSLUCENT)

Hele Ne.

SHEET 5 DRILLING LOG liver Lock & Dam 2 OF 12 SHEETS 10. SIZE AND TYPE OF BIT " Diamond Bit % Dam C. MSL See Remarks 12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500 USAE WES SURDEN SAMPLES TAKEN O BR WES 7-74 14 TOTAL HUMBER CORE BOXES L HAME OF DRILLER IS ELEVATION GROUND WATER Warhurst STARTED IL DATE HOLE 3 Dec 85 TYERTICAL MINELINED DEG. PROM /ERT IT. ELEVATION TOP OF HOLE 730.5 7. THICKNESS OF COMMERCEDEN 38.9' Concrete 18. TOTAL CORE RECOVERY FOR BORING ROCK 98 L DEPTH DRILLED INTO ROCK 60.6" TOTAL DEPTH OF HOLE 119.5 REMARKS
(Delling time, more less, death of meathering, etc., if significant) S CORE BOX OR RECOVERY NO. CLASSIFICATION OF WATERIALS ELEVATION DEPTH LEGEND 40,0 1003 Run: 10 Begin: 30.3 End: 43.1 25 min. 5.05 Rec: хοΕ Remarks: Picked up .25' from run 9, hole is clean. Drill action became rough near 39.5' - probably que to the change in aggregate. 3 42.4: man made break retrieving core from parrel. Run 10 00 Вох 15 Run: 11 Begin: 43.1 End: 46.0 D.T: 35 min. Rec: 4.6 3 45.0: horizontal fracture - possi-bly due to rough drill action. Remarks: Fulled off .11. 100% 2 46.5: man made break. @ 47.1: man made break retrieving core from barrel. Run 11 acx 4 49.6: man made break retrieving core from barrel. Rehab. of Lock & Dam 2, Mon. River BR WES L-7A NG FORM 1836 PREVIOUS EDITIONS ARE DESOLETE. (TRANSLUCENT)

Hele No. HSTALLATION OF 12 SHEETS DRILLING LOG 10. SAZE AND TYPE OF BIT 6" Diamond Bit PROJECT Renab. of MST. See Remarks 12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500 USAE WES 13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN ---3R 728 14. TOTAL NUMBER CORE BOXES & HAME OF DRILLER IL ELEVATION GROUND WATER Warhurst 16. DATE HOLE TOVERTICAL CINCLINED 3 Dec 85 DES. FROM VERT 17. ELEVATION TOP OF HOLE 730.5 7. THICKNESS OF OMCOUNTRICK 18.9" Concrete 18. TOTAL CORE RECOVERY FOR BORING ROCK 98 L DEPTH DRILLED INTO ROCK 60.6" 19. SIGNATURE OF INSPECTOR 119.5 9. TOTAL DEPTH OF HOLE REMARKS
(Drilling than, major lean, depth of westering, etc., if eignificant) CLASSIFICATION OF MATERIALS ELEVATION DEPTH LEGEND 5010 Jun: 12 100% Begin: 46.0 Eng: 52.6 D.1: 35 min. dec: 2.55 nemarks: Ticked up 2o**x** 17 .1' from run 11, gulled off 2.35' this run. - 52.0: man made break retrieving core from parrel. Run € 53.15: horizontal fracture - possibl a macnine break. Run: 15 Degin: 52.8 End: 55.3 D.2: 30 min. 100.5 30x Rec: 4.5 Remarks: Picked up 2.35' from run 12, pulled off .35' 18 this run. Run 13 Run: 14 Begin: 55.3 And: 56.3 D.T: 30 min. Box 56.0 19 3.0 dec: Remarks: Ficked up 100% .35' from run 13, pulled of: 1.45' ⊋ 56.75: 4" aggregate. 56.85 - 57.1: man this run. Went 57.5 back in the hole made rubble getting & tried to pull the core out of the rest of the core - retrieved .25°, therefore the catcher. leaving 1.2' in 58.0 the hole. Run ⊕ 56.45: man made break. Зох 20 | 56.9: Postnot of Jon-preto & Playsonle is Cag .ntuct.

PROJECT

Rehab. of Lock &

Dam 2, Mon. River

BR WES L-7A

(TRANSLUCENT)

ENG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE

Hole No. MATALLATION LUCK & Duff NO. .. PROJECT Rehabilitation of Lock & Dam No: 2, 10. SIZE AND TYPE OF BIT 5" X 7-3/4"

Monongahela River

Monongahela River DRILLING LOG Monongahela River MSL 12. MANUFACTURER'S DESIGNATION OF DRILL See Remarks ORILLING AGENCY USAE WES Failing 1500 11. TOTAL NO. OF OVER-BURGEN SAMPLES TAKEN BR WES L-7A 14. TOTAL NUMBER CORE BOXES NAME OF DRILLER IL ELEVATION GROUND WATER Warhurst & DIRECTION OF HOLE IS, DATE HOLE ? Dec 85 TEVERTICAL THELINED 17. ELEVATION TOP OF HOLE 730.5' . THICKNESS OF OVERBURDEN 58.9' concrete 18. TOTAL CORE RECOVERY FOR SORING ROCK 98 DEPTH DRILLED INTO ROCK 60.6 . TOTAL DEPTH OF HOLE 119.5 RECOV-REMARKS
(Drilling line, meet lees, depth of meethring, sta., if eignificant) CLASSIFICATION OF MATERIALS ELEVATION DEPTH LEGENS 58.9-64.5: Run: 15 Clay Shale: Weathered Begin: 58.3' gray w/occ red. thinly End: 61.8' D.T.: 2 hr Rec.: 3.8 bedded, soft, becoming Bag soft to moderately hard @ 62.7', dense, flat bedding solid, silty to very silty highly fractured w/slick-Remarks: Taped hol to 60.9'. Drill action was smooth en-sides. in clay shale. 58.9-62.7: Essentially rubble due to separation of bedding planes, occ. gravel size siltstone (2"). Run: 16 62.7 Begin: 61.8' 62.3-62.7': Many open fractures-essentially End: 65.5' rubble. D.T.: 2 hr 30 min 9 62.7': Open Hr ← fracture 9 63.3': Open Horizontal Rec: 3.6 Remarks: Taped 20 fracture. hole to 64.5'. @ 63.5': Well healed siltstone filled fracture. @ 63.9': Well healed siltstone filled fracture. 64.5 3 64.15': Open horizontal fracture after Carton reaching surface. 64.5': Silty Shale: Weathered gray 65.5' Run: 17 with very little red. thinly bedded, moderately Begin: 65.5' hard to hard, flat bedding End: 69.3' gen. solid, highly frac-D.T.: 2 hr 10 min tured (3" sp) with gouges Rec: 4.0 (gen. silt filled), slick-Remarks: Taped en-sides, hole to 68.5'. 64.5-65.5': Rubble: As a result of cutting over the core w/ the core bbl., occ. siltstone gravels (2"). 21 65.5-68.51: Many fractures, well healed and open, 2-3" sp., open fractures as follows: 68.0 @ 65.5': H1 \( \text{@ 66.1': Horizontal w/a few} \) fractures just above. @ 67.35': Horizontal 68.5 ENG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT Rehabilitation of

B32

(TRANSLUCENT)

Locks & Dam No. 2. Monongahela River

Hele No. 2-7A

	isión io River	Mononganela River OF 12 SHEET 8					
PROJECTRehapilitatio							
Monongahela River		MSL					
See Remarks		12. MANUFACTURER'S DESIGNATION OF ORILL					
USAE WES		Failing 1500  13. TOTAL NO. OF OVER- DETUNDED UNDISTURBED SUMPLES TAKEN 1					
HOLE HO. (As anoun as drawn	BR WES L-7A	BURD	EN SAMP	LES TAR	0 0		
HAME OF DRILLER	DR WES L-/R	14. TOTA					
Wathurst		IL ELEV			ATER		
DIRECTION OF HOLE	DES. FROM VERT.	16. DATE	HOLE		Dec 85		
	58.9' concrete	17. ELEV					
THICKNESS OF OVERBURDEN	00.6	18. TOTA	LCORER	ECOVER	Y FOR BORING ROCK 98 1		
TOTAL DEPTH OF HOLE	119.5'	19. SIGNA	TURE OF	INSPECT	ron		
LEVATION DEPTH LEGEND	CLASSIFICATION OF MATERIA	LS	S CORE	BOX OR SAMPLE HO.			
- 10.0 - 12H	68.5-69.21:			22	Pune 19		
	l side of vertical f			44	Run: 18 Begin: 69.3'		
	ture is rubble due t	ا ه			End: 73.3'		
	cutting over core.	. 1			D.T.: 1 hr 50 min		
	@ 69.2': Machine brea		-		Rec.: 4.2		
71.0	@ 69.55': Horizontal f	rac-			Remarks: Taped		
7	ture.		}		71.4 hole to 72.7'.		
	9 69.7-69.9': Irregul				Drill action became		
	well healed fracture 3 70.2-70.6': Well he		ł		rough near 71.5'.		
	yerrical fracture.	aren			l i		
72.0	3 71.5': Irregular we	.11	1				
12.	healed fracture.		)				
=====		1	ł		]		
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		- 1					
1 7		į	1				
73.0	@ 73.1': Machine brea	. 1					
	e /3.1 : macmine brea		- 1	23			
			}				
			- 1		Run: 19		
====			1		Begin: 73.3'		
L ==================================		1	!		End: 77.5'		
74.0		}	ļ		D.T.: 1 hr Rec.: 5.0		
		1	ļ	i	Remarks: Taped		
] 7	@ 74.55: Machine brea	ik.	ł		74.55 hole to 77.1'.		
		····					
		]			i		
75.0		ł					
		- 1					
7		- 1	i		1		
			,				
== <u>-/</u> E	3 75.7': Machine brea	ik.	ı		1		
FF +	75.7': Well healed		1				
76.0	vertical fracture.	- 1	1		i		
1 7 7		- 1	ļ	24	i		
		1	- 1				
	3 76.6': MMB						
]		- 1	ł	ļ			
1,,7-11			ļ.	- 1			
77.0-1-1-			Ì		77.1		
		]	- 1				
		- 1					
			ì	j	_		
		1	i		Run: 20		
78.0		- 1	ľ	j	Begin: 77.5		
	2 79 31. Ann handen				End: 81.7'		
1	§ 78.3': Open horizon fracture. Probably		İ		D.T.: 1 hr		
=====================================	machine break.	•	ł	}	Rec.: 4.1		
	machine preds.		1	25	Remarks: Taped hole to 81.2'.		
	@ 78.95': Open horizo	ntal	1	ł	HOTS TO 81.7."		
79.0	fracture. Probably		}		1		
	machine break.	-	ļ	į			
<del>         </del>		- 1	- 1				
<del></del>			l				
1 =====================================		- 1	1	ŀ			
		- 1					
ko.o ===================================		1	ŀ	- 1			

**************************************					50. L.	SHEET 9
10.00	MOROS		a Rive		3 7-374"	OF 12 SHEET
fonongahela River	11. BAYUS				(188 a lest)	
LOCATION (Countmarce or Station)	MSL 12. MANUFACTURER'S DESIGNATION OF DRILL					
See Remarks ORILLING AGENCY	Failing 1500					
JSAE WES	IS. TOTAL			: D+ 0 T	UR 0 E D	UNDISTURBED
MOLE NO. (As about an drawing title) and file member BR WES L-7A					0	0
NAME OF DRILLER	14 TOTAL				40	
PARTHURSE				A 7 E D	160	-
TVERTICAL DINCLINED DES. FROM VERT.	IL DATE	HOLE	! 3	Dec		
THICKNESS OF OVERBURDEN 58.9' CONCTETE	IT. ELEVA	ATION TO	P OF HO	LE	730.5'	
	IS. TOTAL				CRING RO	ck_98
TOTAL DEPTH OF HOLE 119.5"	19. SIGNAT	TURE OF	INSPECT	rom:		
LEVATION DEPTH LEGEND CLASSIFICATION OF WATERIAL	: ك	S CORE	BOX OR	(Drg)	REMAR	IKS
- 60.8		ERY	40.		1	il eignetteam)
80.1' - MB	1		1	i		
1 77 17	1		l			
1 ==== ===	1		!			
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L. 377 F	ł		ŀ	ł		
B1.0-1-1			1	i		
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<u> </u>	1		26			
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7	- 1		!			
		i	1			
82.0	1					
82.1' - MB	(	ļ			Run: 2	1
-	- 1				Begin:	
	- 1				End: 8	
						1 hr 20 mir
03 0				83.0'	Rec.:	
83. <del>0                                      </del>	i	}		33.0		: Taped
====================================	i	- 1			hole to	
<del></del> \	į					
	- 1					
3 83.8' - MB	- 1					
	.	ļ	ļ l			
84.0 Kemoving catch		1	\	1		
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	ĺ			l		
	]					
1 7-1-4	ļ	ļ				
85.0	[	- 1				
<u> </u>	- 1					
	J	ł		85.3'		
1 -1\ /	Į					
	- 1	1				
( <u>∃</u> X	Į.	ļ		86.0'		
86.47	1			00.0		
86.2-35.6': Machine cu	,				Run: 2	
over this part of cor					Begin:	85. <b>9</b> °
86.6-89.3': Well healed				1	End: 9	
vertical fracture.	-	- 1				1 hr 15 mi
1 ====		ŀ				3.3
87.0		1				: Taped
1 = =====	1	- 1		i	hole to	89.3'.
=====		ı				
<del>- </del>  -		1				
@ 87.7' - MB	)	1				
87.7-87.9': Low 4 vo	ell	1				
88.0 healed fracture.			28	1		
]/		- 1		l		
88 4-88.7': Hi 4 well	. ]	Ì		l		
healed fracture.	- 1	ļ				
<del>       </del>	į	- 1				
	j	ł		l		
89.0 - 9 89.3' slick at bottom	of I	- 1		Ì		
		-		89.3'		
recovery.		ļ		37.3		
recovery.		- 1				
1 ====		Į.				
Broken from going over	the					
Broken from going over core with the barrei.	the		15			
Broken from going over			29		10 not	HOLE NO.

B35

Hale No. L-7A

DRIL	LING LO		nio River		ongane ì			OF 12 SHEETS	
		litati	on or Lock a Dam No. 2.		AND TYP			7-3/4"	
Mononga LOCATION			et (en)	11. DATUM FOR ELEVATION SHOWN (TON - MILL)  MSL  12. MANUFACTURER'S DESIGNATION OF ORILL					
See Rem	arks	_,							
USAE WE	AGENCY S				ling 15		OISTUR	9ED UHDISTURSED	
HOLE NO.				13. TOT	AL HO. OF DEN SAMP	LES TAKE		0 0	
	BR WES L-7A					RCORE	OXES 4	.0	
Warhurs		•		15. ELE	VATION G		TER -		
DIRECTIO				16. DAT	E HOLE		RTED	COMPLETED	
T VERT	Car []	******	0E6, FROM VERT.		VATION TO		Dec 85	0.5'	
. THICKNES	1 OF OVE	RHUNDE	w 58.9' concrete				Y FOR BOR		
DEPTH OF	HILLED IN	TO ROCK	60.6		ATURE OF			ING Rock 98	
. TOTAL DI	EPTH OF	HOLE	119.5'						
LEVATION	0 <b>EPT</b> H	LEGEND	CLASSIFICATION OF MATERIA	LS	RECOV-	SAMPLE	(Della me	REMARKS	
	100.0	٠.				17.		oring, etc., if eignificance	
			99.9-100.2': Hi 4 ope	n	1		}	Run: 25	
	#		fracture w/slick.		Į.	33		Begin: 96.8'	
	=====================================	/==-			!	1	}	End: 100.6'	
i	=	-7:-	100.4-100.8': Hi 4 or	en	1	!		D.T.:   hr 10 mi Rec: 4.45	
	101 🗖	<u></u>	fracture w/slick.			1		Remarks: Taped	
	=	-74=	100.9-101.3': H1 ∠ or	er	1	-	101.3'	hole to 100.15'	
	-		fracture w/slick.		1	Į			
	-				1		}		
	=				}	•			
	102_0	_==			1			Dune 26	
		-7=	1 101.9-102.3°: Hi ← 4	pen	1			Run: 26 Begin: 100.6'	
			fracture w/slick.	•	1	34		End: 104.7'	
								D.T.: 1 hr	
		7==-						Rec: 3.15	
	ا	===	102.5-102.8': Hi 4	pen	Ì				
	103.0		fracture w/slick.			;			
ì	l i						103.3'		
		44.4	102.8-103.3': Become:				103.3		
	$\neg$	عصد	harder w/silty pocks	ts					
	=		or gauges.						
	104-0	===				)			
	=	<u> </u>	103.3-107.2':		İ				
	=	7	Clay shale: Weather		1				
	=		highly fractured sp. generally 4-6", gra-		1				
		<u> </u>	becoming red near 1						
İ	105-07	===	soft, gravel size s			35			
ļ	#		stone filled gouges	•		1			
	-		thinly bedded, flat	bed-				Bun. 27	
			ding, very silty.					Run: 27 Begin: 104.7'	
j	<del></del>		103.3-103.6'				105.8'	End: 103.0	
l	106.0		fractured					D.T.: 2 hr	
		/	Partially ble.		i '	1		Rec: 3.7	
-	- 7	,,,,,,	healed					Remarks: Taped	
ł	=	-E-7	Fracture @ 105.8 low	17 P -				hole to 107.2'.	
1	#	7:	open fract		l	36			
Ì	Ĺ <u></u>		@ 106.5-106. Low open						
	107-0	323	Low open fractumew/		1		107.2		
	:	7,77,7							
		***	107.2-111.0': Clay shale: gray,		ì	)			
	=	$\gamma \gamma \gamma$	weathered, fracture	d.		1			
	]	<b>28</b> 8	moderately hard, th						
	108-0		bedded, flat beddi	ıg,					
1	∓		solid dense.			1			
			107.2-107.9': Fracti	red					
ļ			to a rubble; went	ver	ŀ	37			
	=		with core barrel.						
ŀ	ص وه 1		@ 107.9': Open horizont.	ıl					
ĺ	E		fracture.		1				
	]		@ 109.5": Open horizon	tai					
į	-		fracture.						
	=								
	110.0				}	ļ			
NG FORM					PROJECT	Rehab	litatio	on of HOLE NO.	
MAR 71	. 0 30	~ = £ A10f	S COITIONS ARE OBSOLETE		<b>.</b>		io. 2, 3	tonon- L-7A	

Hele No. 1-7A

ING LOG	Oh	io River	Mone	ngahel	a Rive	r	OF 14 SHEETS
		n of Lock & Dam No. 2,					
					LEVATION	, ,motel (78	
rks		··	12. MAN			GHATION OF	DRILL
AGENCY						1000	
As who was		d maer	13. TOT	AL NO. OF Dem Samp	OVER- LES TAKE	EM   0	
		BR WES L-7A	14. 707	-	R CORE	sozes 40	
MILLER-							-
OF HOLE			IS. DAT	E HOLE			COMPLETED
	CLIMED					***	
-	BURGEN	58.9 concrete					
ILLED INT	3 ROCK	0.00					YOCK 90
PTH OF HO	) LE	119.5'	<u> </u>				
DEPTH	EGEND	CLASSIFICATION OF MATERIA	L	RECOV-	SAMPLE	(Dritting	REMARKS
				·	HO.		ne, etc., il eignilleans
10.0							Run: 28
===		110.4-110.5': Fracture	d to	1	l		Begin: 108.0'
	=	a rubble.		1	38	110.5'	End: 112.0'
7-			ital	1	J	1	D.T.: 2 hr 10 mi
., न		fracture.		1	1	111 01	Rec: 3.8'
منظل ۱۱. مو	<b>3</b> 27-1	111.0-113.9':			1	111.0	Remarks: Taped
=\\	$\langle X \rangle$	Clay shale: Red with	some	į			hole to III.0'.
∺	SYN.	gray, soft, weathered	١,	1		1	
	7			ŧ	-	Ī	
<b>=</b> :	及好			}			
12.5	7.56	_				112.0'	
<u> </u>			due			i	Run: 29
<b>=</b>	==1	to drilling over.					Begin: 112.0'
		•	ital				End: 115.8'
7		fracture.					D.T.: 2 hr
13 7		•	Tom		38		Rec.: 2.9'
- <del></del>						1	Remarks: Taped
7-			ital				hole to 113.9'.
			re		1		
	===	•					
7	$\geq $		ured		Bag 4	124.511	
المصدد	EV	to a rubble.		1			
⋾	3				sag 5	113.9	
_ ⊐}	42		Tac-		Bag 6	114.3'	
<b>ہـــ</b> ــ	$\mathcal{K}_{\mathcal{K}}$				Rae 7	114.61	
社	$\mathcal{X}$				~ · ·		
, , , , , ,	= 7						
- <del>النا</del> مديا		dense.		1			
<b></b>			due				
		to drilling over.			ا ۱		
-		114.8~115.1': low an	gle	Ì	39		
7		•	ac-				
116.0		ture.					Run: 30
4-		The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s	tal				Begin: 115.8'
<u> </u>							End: 118.0'
						116.6'	D.T.: 3 hr
7		reactived to a rubb	.E.		bag 8		Rec: 3.1'
∄	7	117.0-119.5':				117.01	Remarks: Taped
11 <del>/ - 11 / - 1</del>			rac-	}			hole to 117.0'.
				į	.		Water color
							changed to pale
7-		thinly bedded, dense.		İ			red at 117.4'.
77	277	solid.					
118-6-	-/-		en	i	i		B 31
コス		fracture.		i	40		Run: 31 Begin: 118.0'
₹-	\		en	1	-5		End: 120.7
	<b>/-</b> \		ا م ام	l	i		D.T.: 1 hr 30 mir
-7/-	\			1			Rec.: 2.5'
	:		ا م		i		Remarks: Taped
19~닉-							hole to 120.7'.
_			led		i		
<b>]_</b>							
		d 119.2' low angle op		Į	,	119.5'	
ゴ	1	fracture with slick					
20.0	1						
	PHOP HOLE ALLED INV	HADDITICATION OF HOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALCOHOLE  ALC	ehabilitation of Lock & Dam No. 2, ela River  (Commence of Printed Prices  ALCENCY  AND COMMENCE  ALCENCY  AND COMMENCE  ALCENCY  AND COMMENCE  ALCED INVO MOCK  119.5'  CLASSIFICATION OF MATERIAL (Documents)  10.0  110.4-110.5': Fracture a rubble.  2 110.5' open horizor fracture.  111.0-113.9':  Clav shale: Red with gray, sort, weathered highly fractured with slicks, thinly bedded. flat bedding, dense, it. 1.0-112.0': Rubble to drilling over.  2 112.0' open horizor fractures.  2 113.2' open horizor fractures.  2 113.6' open fractures.  2 113.6' open fractures.  3 113.9-117.0':  Clay shale: Highly fured, weathered, sof motried, flat bedding thinly bedded, solid, dense.  113.9-114.8': rubble to drilling over.  114.8-115.1': low an partially healed fracture.  115.6' open horizon fracture.  117.0-119.5':  Clav shale: Highly fured, weathered, so mottled, flat bedding thinly bedded, solid, dense.  117.0-119.5':  Clav shale: Highly fured, weathered, so mottled, flat bedding thinly bedded, dense, solid.  4 115.6' open horizon fracture.  117.0-119.5':  Clav shale: Highly fured, weathered, so mottled, flat bedding thinly bedded, dense, solid.  118.6' open horizon fracture.  117.0-119.5':  Clav shale: Highly fured, weathered, so mottled, flat bedding thinly bedded, dense, solid.  118.6' open horizon fracture.  117.0-119.5':  Clav shale: Highly fured, weathered, so mottled, flat bedding thinly bedded, dense, solid.  118.6' open horizon fracture.  119.0-119.5':  Clav shale: Highly fured, weathered, solid.  118.6' open horizon fracture.  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  119.0-119.5':  1	ehabilitation of Lock & Dum No. 2, 10. Size ela River  (Tromationate of Mission MSL  rks  AGENCY  BR WES L-7A  IN TOT 11. ELE  OF HOLE  AL   OF CONTRAINED   18. 97   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 16. 1707   18. 1707   18. 1707   18. 1707   18. 1707   18. 1707   18. 1707   18. 1707   18. 1707   18. 1707   18. 1707	ehabilitation of Lock & Jum No. 2, 10. Size above ela River  (Complement of Minimum MSL  13. MANUFACTURE MSL  As about the desired state of the complement of MSL  As about the desired state of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of the complement of	enablitation of Lock 5 Jum No. c. alte and vive or six let al River (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Complement of States)  Fres (Compl	enablication of Lock 5 Jum No

Hole He. MSTALLATION .... DRILLING LOG aio diver Lock & Dam #2 002 340075 PROJECT TO. SIZE AND TYPE OF BIT OF THE THORSE of Lock ? Dam 2, "on, River Rehab See Remarks Z. MANUFACTURER'S DESIGNATION OF DRILL 7317150 1500 13. TOTAL NO. OF OVER- DISTURBED SURDEN SAMPLES TAKEN 3R /33 1-9 14. TOTAL NUMBER CORE BOXES L HAME OF DRILLER Varnurs T 18 Dec 85 18 Jec 85 IS DATE HOLE TVERTICAL TINCLINED \_ DEG. FROM VERT IT. ELEVATION TOP OF HOLE TTO TE 7. THICKNESS OF OVERBURGEN C. 18. TOTAL CORE RECOVERY FOR BORING D. DEPTH ORILLED INTO ROCK 0.0 19. SIGNATURE OF INSPECTOR My Will in Johorete SAMPLE REMARKS
(Drilling time, motor toos, death of measuring, ord., if algorithms) CLASSIFICATION OF MATERIALS ELEVATION DEPTH LEGEND NAPARA CONTRACTOR OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPE 0.0 Surface Condition: Run: 1 Begin: 0.0 slightly weatheres with light scaling. ∃nď: Maximum exposed aggregate size is 3".
Hole is located on a 15 min. J.T: Зох Rec: 2.2 1 00:3 Remarks: Started surface crack - note to what depth it exhole with a thinwalled diamond bit tends. 0.0 - 10.0 Concrete: gray, preichinately crished Run 1 limestone aggregate, sucangular to angular Run: 2 Run: 2 Begin: 2.2 End: 7.15 0.2: 50 min. has entrained air, has entrapped air, many voids generally less than a diameter D. 2: Rec: 120 4.95 & deep, some aggre-gate are cracked, 0.0 - 1.5: maximum Remarks: --101 aggregate size is 2".1.5 - 10.0: maximum Box 10 E 0.4 5.017 aggregate size is 3"
0.0 - 2.85: vertical crack in core - becomes open = 2.2'. 2.4 - 2.9: incipient vertical crack. 3.75: cooner wire in core. 6.0 @ 5.75: man made break. Eox 7.07 Run 2 Run: 3 7.7 Begin: 7.15 End: 10.65 D.T: 55 min. Rec: 2.85 Remarks: Pulled off χoč .051. 9.0 7 ASBREVIATIONS: D.T: drill time 100% Rec: recovery T.C.B: end of boring. ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. Dam 2. Mon. River HOLE NO. BR WES L-9

Hele Ne. SHEET Z STALLATION vision cnio diver DRILLING LOG incκ \ υ+m +2 OF 2 SHEETS 10. SIZE AND TYPE OF BIT A" DISMOND enan. of Lock & Dam 2, 12. MANUFACTURER'S DESIGNATION OF ORILL See Remarks Failing 1500 0 <u> 3</u>3. 423 14 TOTAL HUMBER CORE BOXES IL ELEVATION GROUND WATER Warhurst BIRECTION OF HOLE IS, DATE HOLE 18 Dec 85 18 Dec 85 TYERTICAL MINCLINED 17. ELEVATION TOP OF HOLE 730.5 THICKNESS OF OVERBURDEN 0.0 IS TOTAL CORE RECOVERY FOR SORING 100 DEPTH DRILLED INTO ROCK 0.0 TOTAL DEPTH OF HOLE 10.65' in Concrete CLASSIFICATION OF MATERIALS RECOV-LEVATION DEPTH LEGEND 10.0 LOCATION: صرهاا E.C.3. - 10.65 kun\_5 YAXOXA LL E F 11.8 L 0 ENG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE Rehab. of Lock & BR WES L-9 Dam 2, Mon. River (TRANSLUCENT)

Hole No SHEET . LOCK LOCK DRILLING LOG Chian diver OF ( ) SHEETS 10. SIZE AND TYPE OF BIT . . . 12 TOT 1 PROJECT <u>ت ۱۳۰۰</u> 12. MANUFACTURER'S DESIGNATION OF DRILL DRILLING AGENCY ALLINE, NOURL WIFFE, ONLY MEET CHORSE CHORSE CHORSE CHORSE CHORSE CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONT USANE 103 NO. 100 As shown on drawing Hiller SE 123 14. TOTAL HUMBER CORE BOXES S HAME OF DRILLER 12 ELEVATION GROUND BATER Jan Taylor-17 Jes of 16. DATE HOLE 16 Dec 65 TVERTICAL CHELINED 17. ELEVATION TOP OF HOLE TTO EL 7. THICKNESS OF CHERRIAREN CONCTETE OU. IN. TOTAL COME RECOVERY FOR BORING ROCK 98 76.15 19. SIGNATURE OF INSPECTOR . DEPTH ORILLED INTO ROCK 47.11 NEMARKS
(Driffing time, mater less, death of specificant) CLASSIFICATION OF WATERIALS ELEVATION DEPTH LEGEND Surface Condition: Run: 1 slightly weathered Segin: 0.0 with light scaling. And: 2.3 D.I: 45 min. Bec: 2.3 Maximum exposed aggregate size is 2". Remarks: --0.0 -Зох Concrete: grav, siliceous with occasional caroonates, maximum aggregate size is 3" river zravel, subrounded to subangular Qua 1 good consolidation, has entratted air, no entrained air, scat-Run: 2 tered voids generally less than 4" diameter Begin: 2.3 4.6 30 min. 2.3 ⊇nd: D.T: Rec: ★ deep,
 ↓ 1.0: man made break retrieving core.
1.C - 1.2: man made chip in the side of Remarks: --100% Box tile core. Sun 2 4.6 - 5.7: side of core is cracked Bun: 3 removing catcher. Begin: 4.6 End: 6.6 D.T: 55 min. Rec: 2.2 100% Remarks: --Зох Run 3 Run: 4 Begin: 6.8 End: 11.6 D.T: 1 hr 50 min Rec: 4.75 @ 7.6: man made break. Remarks: Fulled off .251. 9.0-100% - 9.8: low angle fracture with 1" steel, possibly due to initial intion. PROJECT ENG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE HOLE NO.

B40

Hele Ne. MEET Calo aiver OF 10 SHEETS DRILLING LOG Tour / Dam 45 PROJECT 10. SIZE AND TYPE OF BIT Rehap, of Lock 1 Dam 2, Hon. River LOCATION (C. 12. MANUFACTURER'S DESIGNATION OF DRILL L ORILLING AGENCY 13. TOTAL NO. OF OVER- ORTURNED BURDEN SAMPLES TAKEN A. HOLE NO. (As shown on warring Hiller) 23 (23 1141 14. TOTAL HUMBER CORE BOXES S. HAME OF DRILLER IS. ELEVATION GROUND WATER ISTARTED & DIRECTION OF HOLE IS. DATE HOLE \_\_ FERTICAL \_\_INCLINED 17. ELEVATION TOP OF HOLE 7. THICKNESS OF OVERBURDEN IS. TOTAL CORE RECOVERY FOR SORING. Rock 58 S. DEPTH DRILLED INTO ROCK 19. SIGNATURE OF INSPECTOR TOTAL DEPTH OF HOLE RECOV- SAMPLE REMARKS
(Drilling ima, moor inco, dough of CLASSIFICATION OF WATERIALS DEPTH LEGEND 10.0 Эοх Run 4 Run: 5 12 Run: 5
Begin: 11.8
End: 17.0
D.T: 1 hr 40 min
Rec: 5.05
Remarks: Ficked up
.25' from run 4,
pulled off .4' 12.95: man made break. this run. Box Run 5 ⇒ 17.2: incipient Run: 6 Begin: 17.0 End: 22.0 1 hr 40 min 3**ox** 7 5.0 Rec: Remarks: Picked up .4' from run 5. pulled off .4' this run. HOLE NO. ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.

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27.5 26.3: man made break.  27.5 00  27.15: man made break.  29.5 00  29.5 00  29.5 00  29.5 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6 00  20.6					1		9	i		F	
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	Ì	29-7								F	
		する	ار.		- 1	i				E	
	İ	一日经	U							F	
		42	タオ							E	
NG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT INOLE NO.	NG FORM	<u> </u>	ات			PROJECT			may 5 = 2	上	

DRIL	LING LO		vision Sio River		LLATION K & Da	m #2	SHEET &					
I. PROJECT				10. \$12	E AND TY	Z OF BIT	OF 10 SHEETS					
1. LOCATIO	M (Canda	- C C .C	Dam 2. Non River	11. DATUG FOR ELEVATION SHOWN (TEN - MIL)								
S. DAILLING	AGENCY			12. MANUPACTURER'S DESIGNATION OF DRILL								
4 HOLE HO	4. HOLE NO. (As shown on drawing title)					13. TOTAL NO. OF OVER- DISTURBED UNDISTURBED BURDEN SAMPLES TAKEN						
	BR VES N-1					ER CORE	<del></del>					
L		-		12. EL	EVATION G							
4. DIRECTIO			DEG. FROM VERY.	IG. DA	TE HOLE	1 37 4	ATED   COMPLETED					
7. THICKNES					EVATION T							
B. DEPTH DI					TAL CORE		Y FOR BORING ROCK 98					
9. TOTAL DI	1			l	1100	4/1	0.000					
ELEVATION	30 JO	LEGENO	CLASSIFICATION OF MATERIA (Decomption)		HECOV-	SAMPLE NO.	REMARKS (Drilling time, motor loos, depth of meeting, old, if eigeticant)					
<b>-</b>	-	رزن			+ •		Run: c					
i			3 30.35: man mad	e	l		Begin: 27.0					
		16.	break.				and: 31.1					
ŀ	L. 3	·C			Run		Rec: 5.1					
	31-0	ارُ الله			Ė		Remarks: Picked up 2					
		التين بن			1	5ox	1 .,					
		12			1	11						
	Ξ				}		Run: 9					
	32-	12.7			1		Besin: 31.1 -					
	$\exists$	ارک کر			ł	!	End: 35.1 D.C: 1 hr					
	===	221	3 32.5: machine		100%		Rec: 3.6					
	=	(4)	break.				Remarks: Pulled off					
	33 🞞	احزر			1		.1' this run.					
i	⇉											
	$\exists$	7:01										
	∃	1.7.			1		Ė					
l	34 <u>- ज</u>	الشرية			}	\	Ε					
	∄				1	ox ا	<b> </b>					
	_ <u>-</u> -∃-	ازيزر			]	12	<b>-</b>					
}	∃	<u>₹₩</u>	*	1.0	Run		<u> </u>					
ľ	35 <u>ध्</u> र	5,5	= 34.8: 1" long wide void.	x 2"	, à		E					
	∃.	1.0%										
	4	20	2 35.5: 1" long	x			Run: 10 E					
Ì	∄,	<u> </u>	3/4" wide & dee void.	Þ	;		End: 39.9					
}	36 <u>G</u>	7:21	@ 35.75: machine			. ]	D.T: 1 hr 10 min = Rec: 5.2					
1	丑	14	break. 3 35.9: 2" long	البشي			Remarks: Ticked up					
	3	5/1	deep void.				.4' from run 9.					
ļ	=======================================		@ 36.75; man mad break.	е		1	E					
]:	37 <u>.0</u> 4	32/	37.75: man mad	e		_	E					
1	ボ		break.		100%	Box	F					
ŀ	3	0%					E					
1		25					E					
13	se.c√3	三分				1	E					
ſ	===						E					
	⇒,	0		İ			F					
	7	(2)				İ	Ę					
1,2	59.01.	<u> </u>	33.9: man made				E					
	~ <b>*</b> \\	3:1	break.				E					
	∃-	الخيشال					E					
		ほ			.,		<u> </u>					
	₫.	10			ilun 10	1	E					
NG FORM 1	934		EDITIONS ARE DESCRETE		PROJECT		more no.					

							Hele N		_
DRIL	LING LOG		nvision	LOCK	ATION 1 Do	د. ت		OF 10 SHEETS	.]
	of Lock	٤ ٪	Dam 2, Mon. River	10. SIZE	AND TYP	OF BIT	SHOWN (TEM - A	er)	7
1 DRILLING	AGENCY	<del>••••••</del>		12. MAM	UFACTUR	ER'S DESI	SHATION OF ORIL		1
4. HOLE HO.	(As oferes en	***	5R WES H-1	13. TOT	AL NO. OF DEN SAMP	OVER-	DISTURBED N	UMDISTURBED	
L HAME OF	DAILLER_		5.0 430 (4-1		AL HUMBE				-
S. DIRECTIO	M OF HOLE		056. FROM VERT.	IL DAT	E HOLE	1974	ATED	COMPLETED	1
	S OF OVERE			17. ELE	VATION TO	P OF HO	LE		]
	ILLED INTO			19. SIGN	ATURE OF	INSPECT	OR / J. ///	Rock 98	닉
S. TOTAL DE	EPTH OF HOL	<u> </u>			1.620	ul.	1010	<del></del>	4
ELEVATION	40% O	EMO	CLASSIFICATION OF MATERIA		RECOV-	BOX OR SAMPLE HO.	(Drifting tune, t	MARKS —ior iora, daysh of It, if eignificanu — 9	
	32	Z'n				Зох			F
	=	50				14	Run: 11		F
	TE I	2					Begin: 3 End: 4	9.9 4.95	E
1	41 -	بي:	_				2.7: 1	hr 50 min	F
		<u> </u>	3 41.05: man mas break.	e			Rec: 5	.05	E
	∃≍	جير	Jreak.				Well-Tres		E
	1 7	$\geq$			]				-
l '	], ∃:/	0			1				E
	<b>~~~</b>	<u></u>	10.05	_		l i			F
·		麦	= 42.25: man maa break.	.e	100%	<b>—</b>			E
		2							F
	<del> </del>  33	الرح.							F
	10 <del>- 3</del> ) (	$\geq$							E
	コリ	نرت				Зох			=
		3				15			E
ĺ	<b>∃</b> S								E
	[44 <u>-</u> 된것	$\sum_{n=1}^{\infty}$			}		1		F
	32	2							E
		6			n				F
	30)	25.			Run 11				E
,	45								E
1	<b>∃</b> ∑.						Run: 12 Begin: 4	4 05	F
	J.F.	<u>Z</u> .	3 45.5: 1½" long 3/4" diameter s	X door				9.9	F
	<b>#</b> %	امر	weathered out o				D.T: 1	hr 25 min	E
	46.0		cretion.					.0 Pulled of:	<u>.</u>  =
	4%	<u> </u>	3 46.5: 1" long	કુ.			.95' th	is run.	$\vdash$
	ZE.	2	deep void.				core ba	overloade	Έ
	∃,⊘				100%	_	ing med	hanical	-
	47.	$\leq$				Зо <b>х</b> 16	breaks.		E
		5//	@ 46.9: machine			'			F
	700	إخ	break.				 		E
	当公	4							E
	خ≒ ا	4	3 47.85: machine				1		þ.
Ĭ	48.GC	<i>Σ</i> υ.	break.						E
1	∃ <u>~</u> E	21	ਰੋ 48.35: machine break.						E
Ì	72	5							F
	133	3/1					i 		E
	49.0	3	break.		Run				Ē
	33	2			12				E
	700	3							E
	350	1.6							F
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CHU PUKM	18 74		S FOUTIONS ARE OBSOLETE.		PROJECT			HOLE NO.	

			Course Av			Hole No. 1'-1			
DRIL	LING LOG	Ohio River	,	HOITAL	No 2	SHEET 6			
		ation of Lock & Dam	Lock & Dam No. 2   OF 10 SHEETS						
No. 2.	Monongahela	River	11. DA1	TUN FOR E	LEVATIO	N SHOWN (TEM - MSL)			
L LOCATIO	H (Courd States or	Starting	MSL						
See Rem	arks			UFACTUR	ER'S DES	IGNATION OF DRILL			
USAE-WE			Fa11	ing, Me	del 4	3-6A. Skid Rig			
4 HOLE HO	. (As whom on de	and title	13. TOY	AL HO. OF	OVER-	DISTURBED UNDISTURBED			
		BR WES M-I				0 0			
S. NAME OF				AL HUMBI					
Dan Tav			IS ELE	NOITAY	ROUND	ATER			
& DIRECTIO			14 047	E HOLE	197	ARTED   COMPLETED			
W VERT	CAL   INCLIN	ED DEG. FROM VERT.	12.02.	E HOLE	! 6	Dec 85 17 Dec 85			
T THICKNE	SS OF OVERSURO		17. ELE	VATION T	OP OF HO				
	RILLED INTO RO	300000000000000000000000000000000000000	19. 707	AL CORE	RECOVER	TY FOR BORING ROCK 98 3			
		30.73	19. SIGE	ATURE O	INSPEC	TOR			
S. TOTAL DI	EPTH OF HOLE	97.1	Hers	hel Mc(					
ELEVATION		CLASSIFICATION OF MATERIA		SCORE	SAMPLE NO.	REMARKS (Deliting case, water look, death of			
•	50.00	(Decorption)		ERY	NO.	(Drilling toms, water loos, death of weathering, etc., if algoliteans)			
	70.20	<del></del>		<del> </del>	P				
	1 7	3 50.1: machine break.			Box	Run: 13			
	==			1	17	Begin: 49.9			
		]		1	)	End: 54.0			
	1 7 .	1		İ	ļ	D.T.: 2 hrs			
	L∃ △	.1		1		Rec: 5.05			
	51.03 4	1		į.	J	Remarks: Picked up .95'			
	-	1.		1	Ì	from run 12. Driller			
	! <del>□</del> —	3 51.35: machine break.		1	⊢	overloaded core barrel			
	$-\Delta$	1 51.95: machine break.		i	ł	causing mechanical			
J	-	3 52.3: machine break.		ļ		breaks.			
)	52 A =			1		i <u>i-</u>			
1	52.0	3 52.6: machine break.		!	Box	ļ			
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- 1	7	3 53.35: machine break.			18	E			
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1	-	Solosi Machine Dieak.		Į	Į	Begin: 54.0			
- 1			ŀ	1	Box				
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ł	Ⅎ	ł	- 1	1	• • •	D.T.: 2 hr 25 min Rec: 4.9'			
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-	56- <del>0-1</del> /	1	1	į	ł	Luas: 0.0			
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G FORM 1				PROJECT		<u> </u>			
IAR 71	536 PREVIOU	S COITIONS ARE OBSOLETE.	١.	Lock F	Rehabi Dom No	litation of House No.			
				-ULK G	Annual Miles	M-1			

PROJECT RENADILITATION OF Lock & Dam No. 2. Monon-

Bahela River

**B**46

(TRANSLUCENT)

70.0

ENG FORM 18 36 PREVIOUS EDITIONS ARE DESOLETE.

SHEET 8 HSTALLATION DIVISION DRILLING LOG Lock & Dam #2 Ohio River OF 10 SHEETS BOILET 10. SIZE AND TYPE OF BIT A" "Samond Rehab of Lock & Dam 2, Mon. River MSL See Remarks DRILLING AGENCY USAE WES 12. MANUFACTURER'S DESIGNATION OF DRILL Failing, Model 43-6A, Skid Rig 13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN 0 BR WES M-1 14. TOTAL NUMBER CORE BOXES S NAME OF DRILLER IS. ELEVATION GROUND WATER Dan Tavlor 7 Dec 85 STARTED 16. DATE HOLE 6 Dec 85 TVERTICAL MINCLINEO ---17. ELEVATION TOP OF HOLE 732.5' 7. THICKNESS OF EVERNMENTER CONCrete 60.35" 18. TOTAL CORE RECOVERY FOR BORING ROCK 98 S. DEPTH DRILLED INTO ROCK 35.75 S. TOTAL DEPTH OF HOLE 97.1 T. CORE BOX OR REMARKS
RECOU- SAMPLE (Deling tom, more ioos, down of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the constant of the const CLASSIFICATION OF MATERIALS ELEVATION DEPTH LEGEND Horizontal fracture
Horizontal fracture 27 Run: 20 Begin: 79.1 End: 83.7 D.T.: 1 hr 30 min Rec: 5.1' Horizontal fracture Horizontal fracture
Horizontal fracture
Horizontal fracture Gain: 0.1' Box Horizontal fracture Run Horizontal fracture

Horizontal fracture 20 Box Run: 21 29 Begin: 83.7 End: 88.7 D.T.: 1 hr 40 min Rec: 4.9' Horizontal fracture Loss: 0.1' Horizontal fracture B9.0 Box 30 Run 21 Horizontal fracture Horizontal fracture Clay shale, red and gray 0.0 PROJECT Kenan of Lock & ENG FORM 18 36 PREVIOUS EDITIONS ARE DESOLETE. BR WES M-1 Dam 2. Mon. River

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B47

DRIL	LING LO	× 0	Ohio River	Loc	k & Dam	1 #2		OF 10 SHEETS	
I. PROJECT		L		10. SIZE AND TYPE OF BIT " DE SMORD TO THE TOTAL TO THE TENTE OF THE THE THE THE THE THE THE THE THE THE					
Rehab.	of Lo	ck & Da	am 2. Mon. River	- 1					
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4 HOLE HO	(Ac show		ng upot	ID TOT	DEN SAMP	LES TARI	EM 0	0	
& HAME OF			BR WES M-I	14. 707	AL HUM <b>#</b>	-	oxes .		
Dan Ta	vlor			IL ELE	VA FION &				
& DIRECTIC				IR DAT	E HOLE			Dec 85	
O VERT				17 ELE	VATION TO			520 87	
			Concrete 60.35'					ck 98 1	
S. DEPTH OF				19. SIGN	ATURE OF	INSPECT	rom.		
			97.1' CLASSIFICATION OF MATERIA	<u> </u>	1 CORE	IBOX OR	REMARK		
ELEVATION	DEPTH	1 1	(Desertation)	_	ERY	SAMPLE NO.	Treatmental, etc., 11	toon, down h or	
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ì	_	===1			Ì			E	
	=	===	Horizontal Fractures		1	]	ļ	<b>=</b>	
	71.0		(			1.		<b>=</b>	
		===	J			Box 24	Run: 18	=	
	]				1	"	Begin: 69.	4 F	
1			Clav shale, brown and s	ray.	1	1	End: 74.5	E	
	=		soft to moderately hard	,	i		D.T.: 2 hr	10 min E	
	72.0		Low angle fracture		1	İ	Rec: 5.0' Loss: 0.0'	E	
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j i	=	===			1		durin	g wrapping 📛	
(		====	Low angle fracture		ł	!		F	
1			Clay shale, gray					=	
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	77.0					26	D.T.: 1 hr	30 min	
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NG FORM	1836	PREVIOUS	EDITIONS ARE OBSOLETE	Ī	PROJECT	Rehab	or Lock s		
			(TRANSLUCENT)		Dam 2,	Mon.	River	BR WES M-1	

							Hale No	_		
0811	LING LO	- 1	Object Barre	Lack		No. ?	SHEET OF 10 SHEETS	1		
L		_ 1 _	Ohio River							
No. 2, 1	Mononga	inela R	iver	10. SIZE AND TYPE OF BIT						
See Rem		Mad of 318		MSL 12. MANUFACTURER'S DESIGNATION OF DRILL						
USAE-WE	AGENCY			_Fail	ine. M	odel 4	3-6A, Skid Rig	4		
4 HOLE NO	(As show		u una	12. TOT	AL NO. OF DEN SAMP	LES TARE	3-6A, Skid Rig	]		
1. HAME OF			BR WES M-1			. CORE .		]		
Dan Tav				18. ELE	VATION G	ROUND WA		1		
& DIRECTIO			DES. FROM VERT.	16. DAT	-		Pec 85 17 Dec 85	1		
	EAL []			17. ELE	VATION TO	OP OF HOL	€ 732.5'	]		
7. THICKNE: 8. DEPTH DI							г гол ваятна Роск 98 г	4		
9. TOTAL O			36.75 97.1'	٦.	rehel M	CGinty		_		
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIA	LS	RECOV-	SAMPLE	REMARKS (Drilling time, motor tree, down of months ring, ole. If significant			
<u> </u>	•					-		上		
i	lΞ		Horizontal fracture.		i			E		
1	\ ∃	$\cong$						F		
]								E		
l	۱, <u>,</u> ۲				1		Run: 22 Begin: 88.7	E		
1	91.0						End: 93.7	F		
1	=					1	D.T.: l hr 50 min	F		
1	=		Horizontal fracture.			Box		F		
1	=					31	Loss: 0.65'	E		
1	92.0							E		
Ī	1 3							F		
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	93.0				1	1		E		
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	=		Horizontal fracture. Horizontal fracture.					F		
	94.0		Hot I Louis Live Live Live Live Live Live Live Live			<b>†</b> [		E		
]	] =						Run: 23	E		
1	_				1		Begin: 93.7 End: 97.1	F		
1	=		Horizontal fracture.		ĺ	)	D.T.: 1 hr min	F		
	1 =	===					Rec: 3.25'	-		
ł	95.0						Loss: 0.15'	E		
1	=				1					
	-		Horizontal fracture.		-	Box 32		F		
ļ		====				12		-		
}	96.0				}	1		F		
!	7							F		
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ł								۲		
	=				Run	l		$\perp$		
1	97.6		E.O.B. 3 47.1		23	<del> </del>	1	F		
1	=					1		F		
1							ABBREVIATIONS:	E		
							H.F.: Horizontal Frac-	U.		
	98.0					-	ture	F		
		]					D.T.: Drill Time Rec.: Recovery	F		
	1 =	:			1	ļ	E.O.B.: End of Boring	F		
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ENG FORM	1836	PREVIOL	IS EDITIONS ARE ORSOLETE		PROJEC	T Kehab	initation of work wa.			
MAR 7;			THANSLUCENT		Kape i	a pam La Kive	No. 2. Menon- Mal			

THANSLUCENT

HSTALLATION DOWN 12 hio River SHEET DRILLING LOG OF 1 SHEETS PROJECT 10. SIZE AND TYPE OF BIT Rehab. of Lock & Dam 2, Lon. River LOCATION (Constitutes or Station) 235. 12. MANUFACTURER'S DESIGNATION OF DRILL ICR-II. Series n-100, 110 volt IN TOTAL NO. OF OVER. CHATCHEED 15A3-473 HOLE NO. (As shown on decreng stille) 3R 473 M-2 UMDISTURBED 14. TOTAL HUMBER CORE BOXES . NAME OF DRILLER IS ELEVATION GROUND BATER Dan Taylor PTARTED COMPLETED
22 Cot 85 22 Cot 85 on contiontal is date Hole THERTICAL MINCLINED 17. ELEVATION TOP OF HOLE 7. THICKNESS OF OVERBURDEN .... 18. TOTAL CORE RECOVERY FOR BORING S. DEPTH DRILLED INTO ROCK U.S 19. SIGNATURE OF INSPECTOR 9. TOTAL DEPTH OF HOLE 7,21 in Jonareta 111 RECOV-ERY NO. REMARKS
(Drilling time, water less, depth of meatering, etc., if eignificant) CLASSIFICATION OF MATERIALS ELEVATION DEPTH LEGEND Surface Jonaition:
baily weathered with
extosed agg. - max.
agg. size is 4". Run: 1 Begin: 0.0 Dnd: 1.15 D.T.: 25 min. Rec: 1.15 :00% induniuminumit 0.0 - 3.15 Remarks: -Run 1 Jonoreta: gray, silidebus with some car-Degin: 1.15 Dna: 3.2 D.J.: 2 hrs 5 min. Rec: 2.0 Run: 2 bonates, max. 17g.
size 13 1', river
gravel, suprounted to
supangular, good consolization, entrapped 30x 1 2.0 Rec: Remarks: Pulled off many voids - none greater than to dia-meter & deep unless .35' this run. Drill action was smooth throughout boring. 100% of noted, water was retained 3 .1: manmade break auring retrieval.
5 .7: manmade break Run 2 ABBREVI .. TICKS: during retrieval. arg: aggregate max: maximum D.T.: drill time Rec: recovery E.C.3. = 3.21 2.0.3.: end of boring. LOCATION: 1+ 5.7 mono mono. S 10 13.470 LARGE CHAMBER —-flow —→ LANDWALL PROJECT Rehab. of Lock 6 Dam 2. Mon. River ENG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE BR WES H-2

Hale No. HSTALLATION SHEET DRILLING LOG .ock x J4in ≠2 Chio River OF 1 SHEETS 10. SIZE AND TYPE OF BIT Rehab. of of Lock & Dam 2, Jon. River 1331 18. MANUFACTURER'S DESIGNATION OF DRIFT. 18. MARY ACTUAL 100, 110 volt LORILLING AGENCY ACC-II, JAMES 1-100, L HOLE NO. (As shown on drawing little) 37, 1723 14. TOTAL NUMBER CORE BOXES L HAME OF DRILLER Dan Taylor IS. ELEVATION GROUND WATER STARTED | COMPLETED | 27 Cot 65 20 Jan 25.771 IL DATE HOLE DVERTICAL DINCLINED 17. ELEVATION TOP OF HOLE THICKNESS OF OVERBURDEN 18. SIGNATURE OF INSPECTOR & DEPTH DRILLED INTO ROCK CLASSIFICATION OF WATERIALS

CLASSIFICATION OF WATERIALS

CUTTICLE JOHNSTON: MOG
WILLIEN WEATHERED

WILLIEX WEATHERED

WILLIEX WEATHERED

WILLIEX WEATHERED

WILLIEX WEATHERED

WILLIEX WEATHERED

WILLIEX WEATHERED E TOTAL DEPTH OF HOLE 1.151 1.550 3 more 79 S CORE BOX OR SAMPLE REMARKS
(Drilling time, water took, depth of managering, etc., if significantly ELEVATION DEPTH LEGEND 0.9 Aun: 1 Begin: 0.0 Ind: 1.2 D.I.: 30 min. Rec: 1.1 Remarks: Fulled off ուրարարդություն արտակարկություն արտարակում է արդարդություն Concrete: gray, sili-.!' this run. \_ capus with some carcabus with some callionates, max. arg.
size is 7%, river
gravel, subrounued to
subangular, good consolidation, entrapped Sox 1 Run: 2 Gern: 1.2 End: 3.15 D.T.: 1 hr 20 min lec: 2.05 air, entrained air, Remarks: Picked up many voius - none greater than 3/6", - .5: manmade oreak .1' from run 1; 100% water retained. Drill action during retrieval. Run 2 was smooth through out boring. 3.0.3. 3 3.151 ABBREVIATIONS: agg: aggregate
max: maximum
D.T.: drill time Rec: recovery 2.0.2.: end of boring. LCCATION: Small Champer flow -14.27 H 115 -Middlewall mono. 12 mono. ENG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE PAGIECT Hehab, of Lock & Dam 2, Mon. River BR WES M-3

(TRANSLUCENT)

SHEET LOCK : JAM inio Aivar DRILLING LOG OF 1 SHEETS 10. SIZE AND TYPE OF BIT O' )1 10000 Renab. of of Lock & Dam 2, Hon. Aiver IL MANUFACTURER'S DESIGNATION OF DRILL NO. 11. VOIT NO. 11. VOIT NO. 11. VOIT NO. 11. VOIT NO. 11. TOTAL HO. OF OVER-BURGER SAMPLES TAKEN 1 0 0 See Hemanics JSAS= //ES HOLE NO. (As shown an drawing little) and Blo numbed 0 BR WES W-4 14 TOTAL NUMBER CORE BOXES S HAME OF DRILLER IL ELEVATION GROUND WATER 7./2 Dan Tavlor 125 Oct 55 30 DES. FROM VERY. 25 Oct 85 TERTICAL MINELINED 17. ELEVATION TOP OF HOLE 725.31 7. THICKNESS OF OVERBURDEN O IS. TOTAL CORE RECOVERY FOR BORING 100 GEPTH ORILLED INTO ROCK U. 19. SIGNATURE OF INSPECTOR 3.25' in wondrate TOTAL DEPTH OF HOLE / REMARKS
(Delling two, were loss, death of westering, etc., if significant CLASSIFICATION OF MATERIALS DEPTH LEGEND 0.0 CANODA. Juriace Jonattion: mod-Run: 1 erataly weathered Begin: 0.0 with medium scaling from 725.5' to 730.5' End: 3.25 D.T.: 2 hrs 5 min. Rec: 2.95 haximum exposed aggre-Remarks: Pulled off .3'. Orill action gate size is ". O.O = 2.95 Concrete: gray, sild-ceous with some carwas smooth. 100% 100% of water was retainei. Dox 1 bonates, maximum ag-ABBREVIATIONS: 5.1.: drill time gregate side is river gravel, subrounded to supangular, Rec: recovery good consolidation, E.C.3.: end of entrapped dir, entrained air, many voics generally less than a diameter & LOCATION: lun 1 de≂p. E.O.B. 3 3.25' ..idalewall mono. U5.2 Small Chamber \_ flow Riverwall PROJECT REMAD. OF LOCK & Dam 2. Mon. River ENG FORM 1836 PREVIOUS EDITIONS ARE OSSOLETE BR WES M-4

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Hele Ne. SR WES M-6-86 MSTALLATION LOCK & Dam NO. SHEET DRILLING LOG Ohio River OF [ ] SHEETS Monongahela River PROJECT Rehabilitation Lock & Dam No. 2, 10. SIZE AND TYPE OF BIT 5" X 7 3/4" Monongahela River
LLOCATION (Coordinates or Station) Middle Wall Monolith
25.5' in from land face, 10-U.S. of steps
LOMILLING AGENCY MSL MANUFACTURER'S DESIGNATION OF DRILL Failing Skid Rig USAE WES BURDEN SAMPLES TAKEN HOLE NO. (As shown an aparely state) BR WES M-6-86 L HAME OF DRILLER 14. YOTAL HUMBER CORE BOXES Dan Taylor 15. ELEVATION GROUND WATER L DIRECTION OF HOLE STARTED IL DATE HOLE TYERTICAL MINCLINED 1 29 Jan 86 11 Feb 86 17. ELEVATION TOP OF HOLE 732 y. THICKNESS OF ANATOMAKE Concrete 65.4 18. TOTAL CORE RECOVERY FOR BORING Ruck 97 S. DEPTH DRILLED INTO ROCK shale 19. SIGNATURE OF INSPECTOR 9. TOTAL DEPTH OF HOLE 91.7 Scott Murrell SCOTT BOX OR RECOVERY HO. CLASSIFICATION OF MATERIALS REMARKS
(Desting time, more book, death of Treatment, otal, if aighticans) ELEVATION DEPTH LEGEND Δ Run: 1 Concrete: Looks good, sounds good, 100 Begin: 0.0' End: 2.3° D.T.: 0 hr, 55 min entrapped air, maximum Box size 1/4", entrained air. AB Aggregate - siliceous with D. Press: 220 RPM: 100 REC: 2.3 some calcareous, natural and crushed, maximum 2". Loss: --Δ Run: 2 Begin: 2.3' Looks good, sounds good, End: 4.6 D.T.: Ohr 43 min Δ entrained air, entrapped 100 air, maximum size 1/4". D. Press: 220 Aggregate - siliceous with RPM: 100 Rec: 2.3 some calcareous, natural Box and crushed, maximum size 2 1/2". Loss: -- $\triangle$ Concrete: Run: 3 Looks good, sounds good, Begin: 4.6' entrained air, entrapped End: 6.2' air, maximum size 1/4". D.T.: 47 min Loss: Aggregate - siliceous with 100 Box D. Press: 220 Δ some calcareous, natural RPM: 100 and crushed, maximum Rec: 1.8' size 2 1/2". мв Concrete: Looks good, sounds good Δ entrained air, entrapped air, maximum size 1/4". Aggregate - siliceous Δ with some calcareous. Run: 4 natural and crushed. Begin: 6.2' maximum size 2 1/2". End: 11.25' D.T.: lhr 15 min 100 Box D. Press: 200 RPM: 60 Rec: 5.05'  $\triangle$ Loss: --Δ 10.0-ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE Locks 6 Dam No. 2, Monon-gahela River BR WES M-6-8 (TRANSLUCENT)

Hole No. BR WES M-6-86 SHEET 2 Lock & Dam No. 2 Ohio River DRILLING LOG 10. SIZE AND TYPE OF BIY 4" V 7 7/4"

11. DATUM FOR ELEVATION SHOWN (TEM - MELL) PROJECT KENABILITATION LOCK & DOM NO Monongahela River MSL -Location (Communes or states) Middle will Monolite 25.5' in from land face, 10 U.S. of steps 12. MANUFACTURER'S DESIGNATION OF DRILL Failing Skid Rig 13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN HOLE NO. (A. ---BR WES M-6-86 14. TOTAL HUMBER CORE BOXES Dan Taylor IS ELEVATION GROUND WATER DIRECTION OF HOLE IS. DATE HOLE 11 Feb 86 TVERTICAL [ INCLINED 17. ELEVATION TOP OF HOLE THICKNESS OF CHESCALISE KN CONCRETE 65.4 IS. TOTAL CORE RECOVERY FOR SORING Rack 97 . DEPTH DRILLED INTO ROCK 19. SIGNATURE OF INSPECTOR . TOTAL DEPTH OF HOLE 91.7 Scort Murrell SCOPE BOX OR RECOVERY NO. CLASSIFICATION OF MATERIALS ELEVATION DEPTH LEGEND 5 Δ Concrete: Run: 5 Looks good, sounds good, Begin: 11.25' entrained air, entrapped air. Maximum size 1/4". End: 16.3' D.T.: 0 hr 35 min Aggregate - siliceous with D. Press: 200 RPM: 100 Rec: 5.05 some calcareous, natural and crushed, maximum Box size 2 1/2". Loss: --100 Comments:  $\triangle$ MB To get in box. Box Δ Run: 6 Begin: 16.3' End: 21.4' D.T.: 1 hr 0 min Concrete: Looks good, sounds good. entrained air, entrapped D. Press: 200 RPM: 100 Rec: 4.9' air. Maximum size 1/4". Aggregate - siliceous and calcareous, natrual and Loss: 02.' in hole crushed. Maximum size Comments: 1B 2 1/2". Some large limestone To get in box aggregate in core 100 sample. Box 8 0.0 Lock & Dam No. 2. Monon-gahela River ENG FORM 18 36 PREVIOUS EDITIONS ARE GREALETE BR WES M-6-TRANSLUCENT

	Ohio River	INSTAL			
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-	Concrete 65.4'				<del></del>
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- 1	21.2'				Run: 7
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Hele Ne. PK WES M-6-06

DRILLING	100	i	iston	INSTALL			an No. 2 SHEET 4	
			Ohio River	1g. 51ZE	AND TYPE	ODODYJA E OF BIT	6" X 7 3/4"	
Mon	ongane	la '	River	II. DAY	IN FOR EL	EVATION	SHOWN (THE OF MELL)	$\neg \neg$
LOCATION (Case	Om lan	استاذ	middle wall Monolith ace, 10 U.S. or steps	12. MAN	PACTURE	M'S DESIG	HATION OF ORILL	
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THICKNESS OF	***	964	Concrete 65.4'	_			FOR BORING ROCK 97	-
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TOTAL DEPTH	-		91.7	<u>L</u>		Murrel		
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1	. T	-\			1		Run: 10 Begin: 36.3'	
37.€	ᇽ.		Concrete:				Begin: 36.3' End: 41.5'	
,			Looks good, sounds				D.T.: 1 hr 05 min	
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	桀	4	(B) entrained air, entr		1			
-	₽	+	air, maximum size	1/2".				
-		1	air, maximum size Aggregate - silice	1/2". ous			RPM: 100	
38.6			air, maximum size Aggregate - siliced with some calcareou	1/2". ous us,			RPM: 100 Rec: 4.9	
38.6		7	air, maximum size Aggregate - silice with some calcareounatrual and crushed	1/2". ous us,	100	1.5	RPM: 100 Rec: 4.9' Loss: 0.3 in hole	
38.0		7	air, maximum size Aggregate - siliced with some calcareou	1/2". ous us,	100	15	RPM: 100 Rec: 4.9' Loss: 0.3 in hole Comments:	
38.9		7	air, maximum size Aggregate - silice with some calcareounatrual and crushed	1/2". ous us,	100	15	RPM: 100 Rec: 4.9' Loss: 0.3 in hole Comments: Construction joint	
38.6		7	air, maximum size Aggregate - silice with some calcareounatrual and crushed	1/2". ous us,	100	15	RPM: 100 Rec: 4.9' Loss: 0.3 in hole Comments: Construction joint 40.8', pieces separ.	ated
38.0		7	air, maximum size Aggregate - silice with some calcareounatrual and crushed	1/2". ous us,	100	15	RPM: 100 Rec: 4.9' Loss: 0.3 in hole Comments: Construction joint 40.8', pieces separ when removed from c	ated
38.6		 	air, maximum size Aggregate - silice with some calcareounatrual and crushed	1/2". ous us,	100	15	RPM: 100 Rec: 4.9' Loss: 0.3 in hole Comments: Construction joint 40.8', pieces separ.	ated
		2	air, maximum size Aggregate - silice with some calcareounatrual and crushed	1/2". ous us,	100	15	RPM: 100 Rec: 4.9' Loss: 0.3 in hole Comments: Construction joint 40.8', pieces separ when removed from c	ated
-		7	air, maximum size Aggregate - silice with some calcareounatrual and crushed	1/2". ous us,	100	15	RPM: 100 Rec: 4.9' Loss: 0.3 in hole Comments: Construction joint 40.8', pieces separ when removed from c	ated
-		7	air, maximum size Aggregate - silice with some calcareounatrual and crushed	1/2". ous us,	100	15	RPM: 100 Rec: 4.9' Loss: 0.3 in hole Comments: Construction joint 40.8', pieces separ when removed from c	ated
		7	air, maximum size Aggregate - silice with some calcareounatrual and crushed	1/2". ous us,	100	15	RPM: 100 Rec: 4.9' Loss: 0.3 in hole Comments: Construction joint 40.8', pieces separ when removed from c	ated
-		7	air, maximum size Aggregate - silice with some calcareounatrual and crushed	1/2". ous us,	100	15	RPM: 100 Rec: 4.9' Loss: 0.3 in hole Comments: Construction joint 40.8', pieces separ when removed from c	ated

	To	VISION	INSTAL	LATION L	OCK &	Dam No. 2	SHEET 5	
DRILLING L	06	Ohio River	<u> </u>		ononga	nela River	OF 10 SHEET	
		ion Lock & Dam No. 2.	10. SIZE AND TYPE OF BIT 2" X 7 3/4"  11. DAYOM FOR ELEVATION SHOWN (THE & MELL)					
LOCATION (C	Rahela	River Middle Wall Monolice ace. 10 U.S. of steps	_			MSL		
5.5' in from	land	ace. 10' U.S. of steps	12. MAN	UFACTURE ling Sk		GHATION OF DRI	LL	
USAE WES			13 707	AL WO OF	OVER-	DISTURBED		
HOLE HO. (As also			SUR	DEN SAMP	LES TAR	lw i		
NAME OF DRILLE		BR WES M-6-86		AL NUMBE				
an Tavlor	-		IL ELE	VATION G				
DIRECTION OF HO			16. DAT	E HOLE		Jan 86	11 Feb 86	
MARAICAL C				VATION TO				
THICKNESS OF EX			10 707	44 5005	ACOVER	× 500 000100	Rock 97	
DEPTH ORILLED		26.3' shale	19. SIGH	ATURE OF	INSPECT	OR		
TOTAL DEPTH OF	1		<del></del>		Murrel		WARES	
LEVATION DEPTH	LEGENO	CLAMIFICATION OF MATERIA	445	RECOV-	SAMPLE NO.	(Dedling time,	marer toda, dopth of He., if bigatiseasy	
	<del>                                     </del>			<u> </u>	<del>  '</del>			
=	₹.							
( =	$\Delta$ E			[	1			
	Е							
	}	Construction joint.		1		1		
41.0				ł		Run: 11		
-		SIB .		<del></del>	<del> </del>	Begin: 41	.5'	
_=	‡ _	Concrete:		i		End: 46.4	•	
=	$\Delta$ E	Looks good, sounds	good.	)	Į	D.T.: 1 h		
=	<u> </u>	entrained air, entr			1	D. Press:	200	
42.0_	4	air. maximum size l		{		RPM: 100 Rec: 5.1		
	$\wedge$	Aggregate - siliceo		1	Box :	Loss:		
=	<u> </u>	and calcareous, nate		l	16		Facoure	
=	<b>}~~~</b>	and crushed, maximum size 3".					Encountered on joint at	
1 =	$\Lambda$ E	3124 5 .		}			ide of core.	
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=	}					•		
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44.0	1							
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=	<u> </u>	AR To car in haw						
] =	$\wedge$	dB To get in box.	į			•		
5.0	ړ ــــــــــــــــــــــــــــــــــــ		1					
=	1 <u>,  </u>		1					
=		iB Construction joint						
-		on side.			Bo-			
ı –	. "		ı		Box			
=	, l				Box 17			
46.0								
46.0	Δ							
46.0	$\triangle$	1B Concrete:	2004					
46.0	$\bigcirc$	Looks good, sounds				Run: 12		
46.0	$\bigcirc \bigcirc$	Looks good, sounds   entrained sir, entra	apped			Begin: 46		
47.0	$\bigcirc$ $\bigcirc$	Looks good, sounds	apped /2".			Begin: 46 End: 51.4	51	
	$\bigcirc \bigcirc \bigcirc \bigcirc \bigcirc$	Looks good, sounds entrained air, entrained air, entrained air, entrair, maximum size l Aggregate - siliceot calcareous, natural	apped /2". us and and			Begin: 46 End: 51.4 D.T.: 2 h	5' r 30 min	
	$\bigcirc$ $\bigcirc$ $\bigcirc$	Looks good, sounds entrained air, entrained air, entrair, maximum size l. Aggregate - siliceou calcareous, natural crushed, maximum siz	apped /2". us and and			Begin: 46 End: 51.4 D.T.: 2 h D. Press:	5' r 30 min	
	$\bigcirc$ $\bigcirc$ $\bigcirc$ $\bigcirc$	Looks good, sounds entrained air, entrained air, entrained air, entrair, maximum size l Aggregate - siliceot calcareous, natural	apped /2". us and and			Begin: 46 End: 51.4 D.T.: 2 h D. Press: RPM: 100	5' r 30 min	
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47.0		Looks good, sounds entrained air, entrained air, entrair, maximum size l. Aggregate - siliceou calcareous, natural crushed, maximum siz	apped /2". us and and			Begin: 46 End: 51.4 D.T.: 2 h D. Press: RPM: 100 Rec: 5.1' Loss:	5' r 30 min 200	
		Looks good, sounds entrained air, entrained air, entrair, maximum size l. Aggregate - siliceot calcareous, natural crushed, maximum size-1/2".	apped /2". us and and			Begin: 46 End: 51.4 D.T.: 2 h D. Press: RPM: 100 Rec: 5.1' Loss: Comments:	5' r 30 min	
47.0		Looks good, sounds entrained air, entrained air, entrair, maximum size l. Aggregate - siliceot calcareous, natural crushed, maximum size-1/2".	apped /2". us and and			Begin: 46 End: 51.4 D.T.: 2 h D. Press: RPM: 100 Rec: 5.1' Loss:	5' r 30 min 200	
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48.0		Looks good, sounds entrained air, entrained air, entrair, maximum size l. Aggregate - siliceot calcareous, natural crushed, maximum size-1/2".	apped /2". us and and		17	Begin: 46 End: 51.4 D.T.: 2 h D. Press: RPM: 100 Rec: 5.1' Loss: Comments:	5' r 30 min 200	
47.0		Looks good, sounds entrained air, entrained air, entrair, maximum size l. Aggregate - siliceot calcareous, natural crushed, maximum size-1/2".	apped /2". us and and		17	Begin: 46 End: 51.4 D.T.: 2 h D. Press: RPM: 100 Rec: 5.1' Loss: Comments:	5' r 30 min 200	
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47.0		Looks good, sounds entrained air, entrained air, entrair, maximum size l. Aggregate - siliceot calcareous, natural crushed, maximum size-1/2".	apped /2". us and and		17	Begin: 46 End: 51.4 D.T.: 2 h D. Press: RPM: 100 Rec: 5.1' Loss: Comments:	5' r 30 min 200	
48.0		Looks good, sounds entrained air, entrained air, entrair, maximum size l. Aggregate - siliceot calcareous, natural crushed, maximum size-1/2".	apped /2". us and and		17	Begin: 46 End: 51.4 D.T.: 2 h D. Press: RPM: 100 Rec: 5.1' Loss: Comments:	5' r 30 min 200	
48.0		Looks good, sounds entrained air, entrained air, entrair, maximum size l. Aggregate - siliceot calcareous, natural crushed, maximum size-1/2".	apped /2". Us and and re	100	Box 18	Begin: 46 End: 51.4 D.T.: 2 h D. Press: RPM: 100 Rec: 5.1' Loss: Comments:	5'r 30 min 200 Joint scill	

Hele Ne. BR WES, M-6-86 DIVISION STALLATION SHEET Lock & Dam No. 2 OF 10 SHEETS DRILLING LOG Ohio River PROJECT Rehabilitation Lock & Dam No. 10. SIZE AND TYPE OF BIT 5" Y 7 3/4" Monongahela River 2. LOCATION (Companies or regions) Aiddle Wall Monolith 25.5' in from land tace, IO. U.S. of steps MSL 12. WANUFACTURER'S DESIGNATION OF DRILL 1 DRILLING AGENCY USAE WES Failing Skid Rig UNDISTURBED HOLE HO. (A. BURDEN SAMPLES TAKEN BR WES M-6-86 14. TOTAL HUMBER CORE BOXES NAME OF DRILLER S NAME OF DRIL Dan Tavlor IS ELEVATION GROUND BATER COMPLETED & PIRECTION OF HOLE IS DATE HOLE 29 Jan 86 THERTICAL MINCLINED 11 Feb 86 17. ELEVATION TOP OF HOLE 7. THICKNESS OF CHARMAGEA CONCERE 03.4 TO TAL CORE RECOVERY FOR SORING ROCK 97 26.3' shale 19. SIGNATURE OF INSPECTOR S. DEPTH DRILLED INTO ROCK S. TOTAL DEPTH OF HOLE Scott Murrell T CORE BOX OR RECOV- SAMPLE REMARKS
(Defling time, were lose, dopth of the think time, if significant CLASSIFICATION OF MATERIALS ELEVATION DEPTH LEGEND Box 18 Run: 13 Concrete: Began: 51.4' Looks good, sounds good, End: 56.51 entrained air, entrapped D.T.: 1 hr 10 min  $\triangle$ air, maximum size 1/2". D. Press: 200 Box RPM: 100 Rec: 5.1' 19 Loss: --Comments: Joint still present. 100 55.0 To get in box. 1/8" rebar in strip at 54.2'. Joint on strip at 54.95° Box 20 56.0  $\Delta$ Concrete: Run: 14 Looks good, sounds good, Begin: 56.5' End: 61.6' D.T.: 1 hr 33 min entrapped air, entrained Box air, maximum size 1/2". Aggregate - siliceous D. Press: 200 RPM: 100 and calcareous, natural Rec: 4.6'
Loss: 0.5 in hole and crushed, maximum size 2-1/2". 100 Comments: Joint still present. 59.<del>0 |</del> PROJECT Renabilitation of Lock & Dam No. 2, Monon-ganeta River ENG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE

BR WES M-6-E

**B**59

(TRANSLUCENT)

Hale Ha. A. AES M-h-so

DRILLING LOG	DIVISION	MSTAL			nela River of 10 sheets	7
	Ohio River tion Lock & Dam No. 2,	IO. SIZE	AND TYP	E OF BIT	6" X 7 3/4"	1
Mononganel	a River	3			SHOWN (TOW - MELL)	7
25.5' in from land	face. 10 U.S. of Steps				GNATION OF ORILL	t
L DRILLING AGENCY USAE WES			ing Sk		DISTURBED   UNDIETURBED	-{
A. HOLE HO. (As another on shell and Me manhow			AL NO. OF DEN SAMP		IM I	1
S. NAME OF ORILLER	BR WES M-6-86		AL NUMBE			4
Dan Taylor				_	RTED   COMPLETED	-
VERTICAL CINCLINE	D DEG. PROM VERT.	IS. DAT			Jan 86 11 Feb 86	1
7. THICKNESS OF CHENNYLL	KK Concrete 65.4'		VATION TO			1
& DEPTH ORILLED INTO ROC	™ ?6.3/ shale					i
S. TOTAL DEPTH OF HOLE	91.7	<u> </u>		Murre L		1
ELEVATION DEPTH LEGEN	CLASSIFICATION OF MATERIA			SAMPLE	REMARKS (Drilling time, dutar loca, depth of descripting, also, if eightinam)	
60.0	<u> </u>		<del>  •</del>		•	Ł
	₩		İ			E
1 1 =	1 ,		[	1 1		F
I	Joint fades out in the	113	1			E
$\triangle$ $\vdash$ $\bullet$ . $\bullet$	1		1	} }	Run: 15	E
	YMB		<del></del>	;	Begin: 61.6'	F
1   一人			1	}	End: 66.0' D.T.: 3 hr 10 min	E
1 = ===================================	Concrete:				D. Press: 200	F
	Looks good, sounds g	ood,		Box	RPM: 100	E
	entrained air, entra			22	Rec: 4.6' Loss: 0.3' in hole	E
1 1 =	air, maximum size 1/	٠.			Comments: Water turned	F
				1	a gray-blue milky color	_
<del>                                   </del>	Aggregate - siliceou and calcareous, natu				indicating shale was	Ε
63.64	and crushed, maximum		98	ļ j	reached. 0.3' of gray shale was pulled up	E
	size 2-1/2".			li	with concrete. Closed	F
				} }	contact.	E
						E
64.0	1			} }		上
, E !				Box		F
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	<del>-</del>					F
				]		F
66.0	1				Run: 16	E
	MB's 65.4'-67.7'				Begin: 66.0' End: 71.0'	F
					D.T.: 2 hr 10 min	F
====					D. Press: 200	E
67.0	]	Ì		Box	RPM: 100 Rec.: 4.5'	E
3=0	Shale, gray, moder hard, slightly sil			24	Loss: 0.6' in hole	F
	natu, Silgnery Sil	-,.	96		0.2° ground up	F
			70		Comments:	E
68.0	Healed fracture. Healed fracture.	İ			Top 0.2° fragmented and washed away when	E
	MB HEALTH TIMESTEE			}	drilling started.	F
	1					E
	MB					F
	:	ĺ				F
69.0	MB					F
#===						E
						E
		į.				F
70.0	МВ					F
ENG FORM 1836 PREVIO	US EDITIONS ARE ORSOLETE.	į	Lock &	Dam No	o. 2, Monon- BR WES M-	6-4
	(TRANSLUCENT)		ganela	River		J-0

B60

Holo No. BP WES M-6-86

o. 2 SHEET 8

River of 10 SHEETS Lock & Dam No. 2
Monongabela River DIVISION DRILLING LOG Ohio River 10. SIZE AND TYPE OF BIT 5 V 7 3 1/211
11. DAYUM FOR ELEVATION SHOWN (TOM - MELL) PROJECT Rehabilitation Lock & Dam No. 2. Monongahela River
2. Location (Coordinates or Station) Middle Wall Monolith
25.5' in from land face, 10' U.S. or steps MSL 12. MANUFACTURER'S DESIGNATION OF DRILL A DRILLING AGENCY USAE WES Failing Skid Rig DISTURBED HOLE NO. (As shown on drawing title) BR WES M-6-86 14. TOTAL NUMBER CORE BOXES MAME OF DRILLER 15. ELEVATION GROUND WATER Dan Taylor DIRECTION OF HOLE STARTED IS. DATE HOLE 29 Jan 86 TVERTICAL DINCLINED 11 Feb 17. ELEVATION TOP OF HOLE .....732.51 7. THICKNESS OF GYANNIMANN Concrete 65.4 IS TOTAL CORE RECOVERY FOR BORING 26.3' shale 19. SIGNATURE OF INSPECTOR
91.7' Scott Murrell A. DEPTH DRILLED INTO ROCK SCOTT MUTTELL

SCORE BOX OR

PECOVSAMPLE
NO. (Druling tame, under lose, depth of unanabarring, etc., if eignificant) S. TOTAL DEPTH OF HOLE CLASSIFICATION OF MATERIALS ELEVATION 25 Run: 17 Begin: 70.4' End: 74.4' D.T.: 2 hr 20 min Rec: 3.4' Loss: 0.5', in hole 0.1' fragmented 98 and lost from top of core sample by drilling action. 26 27 Run: 18 Begin: 74.4' End: 79.2'
D.T.: 1 hr 47 min
Rec: 4.8'
Loss: 0.2' in hole 99 28

PROJECT Rehabilitation of

ENG FORM 18 14

Hole Ne. UR WES M-6-86

	DIVISION	PHSTALL	ATION I	OCK &	Vam No. 2 SHEET 9
DRILLING LOG	Ohio River		ч	onongai	nela River or 10 sheets
Monongahel	tion Lock & Dam No. 2,	10. SIZE	AND TYP	E OF BIT	6 ( 7 3/4" • \$но <b>ян (78Ж — №Д)</b>
LOCATION (Commence or	tace, 10 U.S. of steps			:	HSL
DAILLING AGENCY	1ace, 10 _0.5. of 5ceps			id Rig	GNATION OF DRILL
USAE WES		13. 707	L NO OF	OVER-	DISTURSED UMDISTURSAD
and file manhed	BR WES M-6-86	<b></b>			<del></del>
HAME OF DRILLER				ROUND TA	
DIRECTION OF HOLE		IS. DATE		97.5	RTED COMPLETED
MAEMAICUT -INCLIN	ED DEG. FROM VERT.	L			Jan 86 11 Feb 86
THICKNESS OF OWNER	Concrete 65.4			OP OF NO	
DEPTH DRILLED INTO RO	20.3 311416				
TOTAL DEPTH OF HOLE	91.7'			Murrel.	
LEVATION DEPTH   LEGE	CLASSIFICATION OF MATERIA	LS	RECOV-	SAMPLE HO.	REMARKS (Driffing time, outprison, double of orestoring, etc., if highlighers)
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	⊒				
TEE	<u> </u>	i		29	
===	Shale, gray, moderatel	v ]			Run: 19
\ _ <del> </del> <del></del>	hard, slightly silty.	ļ			Begin: 79.2"
βι. <del>0 - 1-7</del>	-1	1		1	End: 84.5' Rec: 5.0'
1 ====	<b>J</b> ii				D.T.: 2 hr
<del> </del>	-	}		}	Loss: 0.3' left in
1 3 ===================================	Open vertical fracture	g.	98	i	hole.
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84.0	<u> </u>	İ			
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====	<del>-</del> Ì	j			
7	<del>T</del> i	1			
1 15 T	Shale gray, moderately	1			Run: 20
85.0	hard, slightly silty.	- 1			Begin: 84.5'
E					End: 87.0
====	Healed vertical fractur	re.			Rec.: 2.6' D.T.: 50 min
====	립	j	90		Loss: 0.2' left in
	-1			31	hole
86.0	<u> </u>	-			
	3	1			
		Ĺ			
87.0				Ī	
1 7		1			
7	3	- 1		}	
	Shale gray, moderately				Run: 21
88.0	hard, slightly silty.			İ	Begin: 87.0' End: 91.7'
		-			Rec: 4.7'
1	<del></del>	ì	i	32	D.T.: 2 hr 40 min
		}			
	Healed fractures.	1	100		
189. <del>0 - j-</del>	-		į		
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C FORM	SUS EDITIONS ARE DESCLETE		POJECT		o. 2. Monon- BR WES M-

Hole No. BR WES M-6-86

_				1,000	LATION	LICY +	11400 343	11466
DRILL	LING LO	ော်	Ohio River .				hela River	OF 10 SHEETS
			Lon Lock & Dam No	10. 117	AHO TYO	4 QF BIY	0 X / 3/4"	A 246 13
		gahela		11. DAY	UM FOR E	CEVAYIO	SHOWN ITOM - MELL	<del>,</del>
LOCATION	· (Conta	Mes or \$10	middle Wall Monolith				MSL	
.5' ir	from	land f	are Middle Wall Monolith face, 10 U.S. of steps	12. MAN	UFACTUR		GHATION OF DRILL	
AILLING	AGENCY			Fail	ing Ski			
AE WE				13. TOT	AL NO. OF DEN SAMP	OVER-	018708860	UNDISTURBED
# #10 nu			BR WES M-6-86	ļ——				<u>.                                    </u>
AME OF	DRILLER		5K 425 K 5 55		AL HUMBS			
n Tavi	lor	-		18. ELE	VATION O			
PECTIO	4 OF HO	LE		IS DAT	E HOLE	1574	M4E0 100	
		WCL    E0	DEG. FROM VERT.					1 Feb 86
THICKNES	205 646	-	Concrete 65.4'	17. ELE	VATION T	0P 0P HO	LE 732.51	
				18. TOT	AL CORE	RECOVER	Y FOR BORING R	ock 97 *
-				19. SIGN	ATURE OF	INSPECT	OR	
TOTAL DE	PTH OF	HOLE	91.7'			Murrel		
EVATION	DEPTH	LEGEND	CLASSIFICATION OF WATERIA		RECOV-	SAMPLE NO.	(Delland standard	KS
	•	1 1	(Decargarism)		EAY	NO.	(Dretting rises, main	II articulturani
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			Shale, gray, moderate	.y	l	33	ļ	
1	=		hard, slightly silty.		1	1		
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i			E.O.B. @ 91.7'.					
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FORM .	10 74				PROJECT	Pahah	llitation of	HOLE NO.
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B63

Hole No. BR WES R-1-86

DRILL	LING LO		vision Ohio River	5 .	ration L		Dam No. 4.	SHEET   OF   SHEETS
		litati		10. SIZE	TY ONA	OF SIT	SHOWN (TWW - MSL)	all
Mononga 2 Location	Coordena	iver	west Upper guard wall,	MS		FEATION		}
monoliti	R-5.	in lit	me w/MPer guard wall, in from land face	1			SMATION OF DRILL	
22 C 4 E 1.11	e e			12 TOT	C-IL.S AL NO. OF DEN SAMP	CTIES	K-100, 110 vol	UMBHSTUR BED
A HOLE NO.	(A+	-	BR WES R-1-86	<b></b>				
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7. THICKHES	15 OF OVE	RBURGE	,		VATION T			100
S. DEPTH OF	IILLED IM	TO RESIDE	k concrete 1.7'		ATURE OF		Y FOR BORING	
9. TOTAL DE		OLE	1.7'					
ELEVATION	DEPTH	FEGEND	CLASSIFICATION OF MATERIA (Decorposition)	u	RECOV-	SAMPLE NO.	(Drifting two, mark womaning, star.	loos, death of
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(	1.0		crushed siliceous agg: maximum 1-1/2".	egate		}		E
	=		waximum 1-1/2 .		<u> </u>			E
		ΔΙ	Has entrapped and enti	rained	}			<b>=</b>
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ENG FORM	1836	P R E V101	IS EDITIONS ARE DESOLETE.				ilitation of	HOLE 80.
MAR 71	- 3-		(TRANSLUCENT)		'Locks gahel	6 Dam a Rive:	No. 2. Monon-	BR WES R-1-6

Hole Ne. HSTALLATION DRILLING LOG Lock & 33π -42 Chio diver OF 1 SHEETS 10. SIZE AND TYPE OF SIT Rehab. of Location (Comme of Lock & Dam 2, Hon. River 1.31 L HANUFACTURER'S DESIGNATION OF DRILL See Romarks ECR-II. Peries n-100, 110 volt USAE-VES
L HOLE NO. (As shown an drawing title! 53. JES 13. TOTAL NO. OF OVER-14. TOTAL NUMBER CORE BOXES L NAME OF DRILLER IS, ELEVATION GROUND WATER Dan Taylor oo der row vent. 25 Cot 05 IS. DATE HOLE 25 Cct 65 TVERTICAL TINCLINED IT. ELEVATION TOP OF HOLE 725.31 7. THICKHESS OF OVERBURDEN A O 18. TOTAL CORE RECOVERY FOR BORING. B. DEPTH DRILLED INTO ROCK .... 19. SIGNATURE OF INSPECTOR 4 Jak in Janorete CLASSIFICATION OF MATERIALS ELEVATION DEPTH LEGEND 0.3 Run: 1 Surface Condition: Mod-Begin: 0.0 erately weathered Ind: 1.15 with mealum scaling 100% max. agg. size is 2 . 1 hr. Rec: Severe scaling is at 1.1 Remarks: Fulled off joints. Run U.J - 3.1 Joncrete: gray, sili-Run: 2 deous with some car-3ox 1 Degin: 1.15 conates, max. agg.
size is 3", river
gravel, suprounted to
supangular, good consolidation, entrapped 100% End: 3.1 D.T: 1 h: 1 hr 45 min. Rec: 2.0 Remarks: Picked up .05' from run 1. Drill action was many voids - none greater than " lia-meter à deep unless smooth throughout Run 2 boring. 100% of water was retained. noteu, noteu, 4.75: 3" steel. 4.65: 1" steel. 2.1: void - 3/8" diameter, 2" deep. ABEREVIATIONS: agg: aggregate max: maximum
D.T.: drill time 3/4" long. Rec: recovery I.C.B.: end of boring. E.O.B. @ 3.1' LUCATION: mono. 14 mono. 15 HELVI RIVERNALL U5.2' Small Chamber -- flow-HIDDLEWALL ENG FORM 18 36 PREVIOUS EDITIONS ARE OBSOLETE. Dam 2, Mon. River BR WES R-3

B65

(TRANSLUCENT)

Hele No. SHEET MOITALLATION оск и Зап «2 DRILLING LOG OF I SHEETS Unio diver IG. SIZE AND TYPE OF BIT LAMOTIC Renab. of Lock & Dam 2, Mon. River LOCATION /C. 12. MAMUFACTURER'S DESIGNATION OF ORILL See Femanica KOR-II. Series K-100, 113 JSAL-JES S. TOTAL HO. OF OVER-MOLE NO. (As shown as drawing sitted 3R VIES R-4 14. TOTAL HUMBER CORE BOXES L NAME OF DRILLER IL ELEVATION GROUND TATER Dan Taylor 124 Cct 55 24 Oct 25 O DES. FROM VERT. - VERTICAL - INCLINED IT. ELEVATION TOP OF HOLE 715.0 THICKNESS OF GVERSUNDEN 18. TOTAL CORE RECOVERY FOR BORING L DEPTH ORILLED INTO ROCK 0.0 19 SIGNATURE OF INSPECTOR 1/1/101 . TOTAL DEPTH OF HOLE in Jonorete L'aprent (Drilling Issis, werer loos, stepph of westlanding, one., )) eignelicans) CLASSIFICATION OF MATERIALS ELEVATION DEPTH LEGEND U.D Surface Condition: badl; Run: 1 weathered with severe Begin: 0.0 scaling - max. agg. size is 3". 1.15 End: 100% D.T.: 40 min. Rec: 1.15 0.0 - 3.1Remarks: -Concrete: gray, sili-Run 1 ceous with some carbonates, max. agg. size is 3", river gravel, suprounded to Run: 2 Sox 1 Begin: 1.15 3.1 End: 3.1 D.T.: 1 hr 45 min. ing: 3.1 i.T.: 1 hr 45 min. E lec: 1.95 lemarks: 100% of water was retained. Drill action was 100% supangular, good con-solication, entrapped Rec: Remarks: 100% of many voids - none greater than to diameter a deep unless Drill action was smooth throughout boring. 3.0HZ roted,
2.1: 3/4" long & ½" Run 2 ABBREVIATIONS: deep void. agg: aggregate max: maximum 0 .2: incipient cracks - through D.T: drill time some agg.

3.35: manmade broak Rec: recovery E.O.B: end of during retrieval. boring. 9 .5: manmade break during retrieval. LOCATION: E.O.B. @ 3.1' Liquravia mono. mono. 17 18 47'44 J 155 Small Chamber - flow -MIDDLEWALL Dam 2, Mon. River ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. BR WES R-4 (TRANSLUCENT)

Hele Ne. SR WES R-5-86

								WES R-5-8
DRILL	ING LO	_	vision Chio River	Monor	ngahela	SCK &		PET 1
PROJECT	Reha	bilita	tion of Lock & Dam	19. \$12 E	AND TYPE	T OF BIT	6" Y 7 7/4"	
No. 2, M			River Wall Monolith	MSL	UM FOR EL	EVATION	SHOWN (THE - MEL)	
<u>R-23, 6.</u>	7' U.	<u>S. of</u>	R-24 Joint and 5.8'		UFACTURE	EM-2 DE31	GHATION OF DRILL	
USAE-WE		Landw	ard from river face		ling Sk		OISTURNED	
HOLE HO.	4	-		TOT	AL NO. OF DEN SAMPI	LES TARE	191	######################################
NAME OF D			BR WES R-5-86		AL NUMBE			
Dan Tay	lor -			IS ELE	VATION GE			
DIRECTION			DES. PROM VERT.	IL DAT	E HOLE			Jan 86
THICKHESS			<del></del>	17. ELE	VATION TO			
DEPTH ORI			3113 CONCLUC				y FOR BORING ROCK	99
TOTAL DEF			90.7'		ATURE OF		OM	
LEVATION	0.5054	LEGEND	CLASSIFICATION OF MATERIA			BOX OR	REMARK	S leas, death of
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Hele Ne. BR WES R-5-86

	LING LO	× 01	Ohio River	Monor	nganela	RIVE:	Dam No. 2,	SHEET 2 OF 10 SHEETS
No. 2			tation of Lock & Dam a River				SHOWN (THE - MELL)	
			River Wall Monolit f R-24 Joint and 5.8'	h MSL				
1 DRILLING	AGENCY	lane	dward from river race.		ling Sk		GHATION OF DRILL	
USAE	-WES		BR WES R-5-86	13. TOT	AL NO. OF	OVER-	OLETURE ED	UNDISTURBED
			BK ME2 K-3-00		AL HUMBE			
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& DIRECTIO	H OF HOL			IS. DAT	E HOLE			LETEO
VERT	CAL []	METIMES	OEG. PROM VERT.	17. ELE	VATION TO			4 Jan 86
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S. TOTAL OF			23.2' shale	1	ATURE OF		rom	l
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	17.₽∃	Δ	Aggregate natural and				RPM: ≈100	-·
	Ξ		crushed, maximum size 2-1/2", siliceous.	•			Rec: 5.0'	
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			(TRANSLUCENT)		gahela	River	v. ∠, ∧onon-	ea x-j-

Hale Ne.3R WES R-5-86

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Rei	140111	tation of Lock & Dam	10. SIZ	E AND TYPE	OF BIT	6" X 7 3/4"	
Monor	iganel	a River			EVATION	SHOWN (THE - MELL)	
6.7' 1	J.S. o	f R-24 Joint and 5.8'	12. MA	HUFACTURE		SHATION OF ORILL	
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		DEG. FROM VERT.	16. DA	TE HOLE			Jan 86
			17. EL	EVATION TO	P OF HO	LE 730.5'	
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and in  To-mone and in  To-mone and in  To-mone and in  To-mone and in  To-mone	Rehabilitation of Lock a Dam Monongahela River  **Commissions of States**  **Commissions of R-24 Joint and 5:8'  **ACEMICY landward from river face  **MES**  **Concrete:  Locks good, sounds goon for the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the 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WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. WES R-54 Joint and 5:8' Failing Sk. 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WES R-54 Joint and 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Joint And 5:8' Jo	Rebapilitation of Lock a Dam Monongahela River    Commence	Membritis and the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the con

Hele Ne. uk WES R-5-86

0011	ING LO	G 101	VISION	MOSC	ATION L	RIVER	Jam NU. L. SHE	LT 10 sheets
PROJECT			Ohio River action of Lock & Dam				6" X 7 3/4"	SHEETS
No. 2.	Monor	gahela	River	II. BAT	UM FOR EL	EVATION	र रायक में राज में के स्थार	
LOCATION	(Comes	er 511	River Wall Monolit	MSL				
R-23.	AGENCY	of	R-24 Joint and 5;8'		ufactume Ling Sk		GNATION OF DRILL	
USAE-	WES		a utlat		AL NO. OF			
MOLE NO.	(A 0 0000		BR WES R-5-86	<b></b>			<del></del>	
HAME OF	_		<del></del>		AL HUMBE			
Dan T	aylor		<del></del>	├			MTED COMPLE	780
DARBAIL			DES. FROM VEST.		E HOLE	! !	8 Dec 85 : 24 J	an 86
THICKNES					VATION TO			
DEPTH OR					AL CORE		FOR SORING ROCK 9	9 1
. TOTAL DE	PTH OF	HOLE	90.7'		ott Mur			
LEVATION	DEPTH	LEGEND	CLASSIFICATION OF WATERIA		1 CORE	SAMPLE HO.	REMARKS (Drilling time, motor look	, desth of
			(Decorption)		ERY	HO.	manufacture ate, if sign	ulicare
	20.0	Λ						
1	$\exists$	$\Delta$			[	10		
ĺ	-				1			
- 1	3				Ì	]		
ł	31.0∃	_4	мв		<u></u>			
{	∃		Concrete:		}			
	≒	<b>^</b>	Looks good, sounds goo		l			
}	=	$\hookrightarrow$	Entrained air, entrappair, maximum size 1/2			j		
1	=				]	]	Run: 4	
ţ	32.0	$ \wedge$ $ $	Aggregate - siliceous, natural and crushed.	•	1		Begin: 31.0'	
1	∃	4>	maximum size 2".			11	End: 36.2'	-4-
1	Ε	į	- -				D.T.: 2 hr 42 D. Press: 220	w1D
!	$\exists$	$^{\prime}$			100		RPM: ≈100	
1	Ε	4			100		Rec: 5.1'	
İ	33.0□						Loss: 0.1' in	hole
1	⇉	~~~	MB					
Į	⊣	$\triangle$						
!	∃			į		[		
1	., .=							
}	34.0	$\triangle$				<b>†</b>		
}	コ		l.		· '			
ļ	$\dashv$							
-	∃	$\Delta$				12		
1	<del>۔</del>	~	MB					
1	E	_						
i	∃	$\triangle$						
1	7	1						
Į	Ⅎ							
Į.	36.0	$\Delta$	WB.					
ļ	⇒		MB					
1	⇉	_	Commence					
j	$\exists$	$\Box$	Concrete: Looks good, sounds good	. 1			Run: 5	
<b>\</b>	7	1	Entrained air, entrappe				Begin: 36.2'	
1	37.4	_ ,	maximum size 1/4".				End: 41.2' D.T.: 0 hr 57	min
ı	∃	$\Delta$	Aggregate - siliceous,	,			D. Press: 240	m T 11
l	크		natural and crushed, ma	xioum		13	RPM: 2100	
j	$\Xi$	<u>,</u>	size 2".			`	Rec: 5.1'	
1	$\exists$	$\Delta$					Loss:	
	38.0				100			
	⇉				100			
	コ	$\Delta$						
}	⇉	ļ						
}		, 1			l i			
}	39.0	$\Delta$						
ļ	⇉	~~						
[		!						
}	ᆿ	$\Delta$				1		
ľ	40.0	Ì			}			
			S EDITIONS ARE DESOLETE.		PROJECT	Kenan	Titestion of	OLE #0.
GPUKM							o. 2, Monon-	

Hole No. JR WES R-5-86

DRILL	ING LO	G O	Ohio River	Monor	ganela	Kiver	of 10 sheets
PROJECT	Rel	abili	ation of Luck a Dam	10. SIZE	AND TYP	OF BIT	5" X 7 3/4"
OCATION	1Carrella		River Wall Monoll	h MSL			
R-23.	6.7' t	J.S. 01	R-24 Joint and 558'	12. MAN			GHATION OF ORILL
USAE-	WES				Ing Sk		
HOLE NO.	(A/		BR WES R-5-86	<b></b>			IN !
AME OF				$\overline{}$	AL NUMBE		
Dan T	avlor			-		1874	ATTED   COMPLETED
************			DES. PROM VERT.	ļ	E HOLE		5 Dec 85 24 Jan 86
-	0 0VE	ROURDE	67.5' concrete		VATION TO		V FOR BORING ROCK 99
EPTH DR			23.2' shale	19. SIGN	ATURE OF	INSPECT	
OTAL DE	PTH 0F 1	HOLE	90.7'		S CORE	BOX OF	REMARKS
	DEPTH	LEGEND	(Description)		RECOV-	NO.	weekening, etc., if eignelisand
	0.0				<del></del>	<del>- '-</del>	
l	7	, [			(		
- 1		$\Delta$				14	
	∃	.				•	
ļ.	الم					[	
	=		мв			<u> </u>	
Ţ	_=	.	Concrete:				
-	$\exists$	$\Delta \mid$	Looks good, sounds go				Run: 6
Ł	, , ; ; ;		Entrained air, entragair, maximum size 5/				Begin: 41.2' End: 46.2'
ľ	2.0=					15	D.T.: 2 hr 42 min
	∃	<u>سجيرا</u>	Aggregate - siliceous (B natural and crushed.				RPM: ≈100 D. Press: 240
	===		imum size 2-1/4".				Rec: 5.0'
j	∃	$\Delta$			100		Loss: 0.1'
ķ	3.	l					Comments: Barrel came up without core.
1	╡						Fished for it without
}	<b>-</b> ゴ	~~~	1B				success. Tried again
	=	. 1	_				21 Jan and recovered core.
k.	ته. 4	$\Delta$ )			'		
1	7						
Ì	$\exists$	$\Delta$				1,	
İ	$\equiv$	23				16	
	#	į					
f	5.0	$\Delta$ $\perp$		i			
	3						
- [	궄						
- [	7	$\Delta$					
ķ	<u>[</u> 6.6	Į					
	$\exists$						
-	<b>=</b>	$\overline{\wedge}$	ß Concrete:				
	===	_	Looks good, sounds go	od.			Run: 7
k	7.0	_	Entrained air, entrap	ed	100		Begin: 46.2' End: 47.5'
ľ	Ξ,	Δ	air, maximum size 1/4	•			D.T.: 1 hr 08 min
1	=	1					D. Press: 240
	7	~~~	1B				RPM: 2100 Rec: 1.3'
- 1	3					,,	Loss:
۴	8.0					17	Comments: Striations
1	7				'		on core caused by retrieval.
1	$\exists$	4					751175197
1	3	1					
k	<u>-</u> و.و	$\Delta$					
ſ		_					
	્ર∓		18		100		
1	$\exists$	$\triangle$					
L	٦,,						
					1	l	1
FORM 1			S EDITIONS ARE OBSOLETE.		000.	- 11	tittation of HOLE NO.

Hele Ne. DR WES R-5-66

DRILL	LING LO		Ohio River	Monon	ganela	KIVOT OCK G	OF 10 SHEET
PROJECT	ne.	nabili	tation of Lock & Dam	10. SIZE	AND TYP	E OF 817	6" X 7 3/4"
			a River Wall Monolit		UN FOR EL	EVATIO	SHOWN (YEW - MELL)
R-23.	6.7'	U.S. 01	R-24 Joint and 5:8"		UFACTURI	EA'S DESI	GHATION OF DRILL
DRILLING	AGENCY	land	Ward from river face	Fail	ing Sk	id Rir	
USAE-			BR WES R-5-86	IA. TOT	AL NO. OF	OVER-	OHSTUNGED   UNDISTUNGED
				14. TOT	AL HUMBE	R CORE	DOEES 32
Dan 1	<del>omili<u>e</u></del> Tavlor				VATION G		
DIRECTIO	4 OF HO			IS. DATE	E HOLE		9 Dec 85 24 Jan 86
VER 714	CAL []	#C   IMEO	DEG. FROM TERT.		VATION TO		<del></del>
THICKNES	5 OF OVE	RBURDE	67.5' concrete				y FOR BORING ROCK 99
DEPTH DA	-	TO ROCK	23.2' shale		ATURE OF		
TOTAL DE	PTH OF	HOLE	90.71		tt Mur		
EVATION	DEPTH	LEGEND	CLASSIFICATION OF WATERIA		RECOV-	SAMPLE NO.	REMARKS (Drefting type, water took, depth of meaboring, etc., if eignificant
•	50.b.	-			•		
- 1	=		Concrete:	a 1			Run: 8
1	=	<u></u>	Looks good, sounds good Entrained air, entrappe				Begin: 47.5' End: 12.3'
i			air, maximum size 1/2"		100	ĺ	D.T.: 1 hr 11 min
- 1	=	$ \cdot $	Aggregate - siliceous.			18	D. Press: 240
	51.0	ر ئے	natural and crushed, m	3 X 1 12 U 12			RPM: ≈100
	3		MB 51ze 2-1/2".	ĺ			Rec: 4.8'
İ	=						
]	=						
	52.0						
	=		11 <b>B</b>				Run: 9
		- 1	Concrete: Looks good, sounds goo	,			Begin: 52.3'
j	╡	$\Delta$ $ $	Entrained air, entrapp				End: 57.1'
	ູ,⊐	_	air, maximum size 1/2"			19	D.T.: 2 hr 21 min D. Press: 240
1	53. <del>v  </del>		Aggregate - siliceous	and			RPM: 2100
İ	E		calcareous, natural an	d	90		Rec: 4.5'
		4	crushed, maximum size	2-1/4"	70		Loss: 0.4 ground up
l	3			,			Comments: Break at 55' had missing section
-	54.67	$\overline{}$	4B	ļ	,	l j	approximately 0.4' due
	E	۱۵		j			to section being broke
- 1	⇉			į			up. This section
	$\dashv$			1			was removed from core barrel as aggregate an
	⇉	$\Delta$					loose pieces of con-
1	55. <del>0 ]</del>	4	MB	ł	ł		crete. This is best
ļ	$\exists$	X	w.m.				estimate of length of
	三	<u> </u>	ME	1		ļ	section. Measuring tape lowered to bottom
}	$\exists$	$\triangle$		İ	Į	,,	of hole read 57.1'.
1	∃					20	. ==
- 1	56.0	_ ,			1		
I	コ	$\Delta$				1	
1	_=			}	1		
ł	=	, I		]	1		ı
].	., ,⊐	$\Delta$		j	1		
ľ	57.8		MB	ŀ			Run: 10
1	$\exists$		Concrete:	. 1	İ	1	Begin: 57.1'
	$\exists$	47	Looks good, sounds good Entrained air, entrappe				End: 62.3° D.T.: 1 hr 45 min
]	3		air, maximum size 1/4"			j	D.T.: 1 hr 45 min D. Press: 240
],	E0.82	_	·		j		RPM: 2 100
}	,°.•=	$\triangle$	Aggregate - siliceous - calcareous, natural and		1	ł	Rec: 5.1'
	3		crushed, maximum size		İ	21	Loss: 0.1' in hole
	$\exists$				ŀ		
[	Ε	$\Delta$		1	i		
ĺ,	Fa.ez	Í			1		
- }	,,, <u>,</u>	,		1	ł		
	∃.	$\triangle$			1	ł	
		- 1			ļ	ļ	
]	$\exists$						
- 1.	50.0	$\Delta$		1	1		
			EDITIONS ARE OBSOLETE			'	ilication of Hore no.

DRILLING	LOG	- }	Ohio River	Honor	Saueta	Aiv.i.		OF 10 SHEETS
NO. 2 M	Reha	01110	ation of Lock & Dam	10. 1128	AND TYP		5" Y 7 3/4"	
No. 2, M	nong	anela	River Wall Monoli		re rost El	LEVATION		•
<u>R-23</u> , 6.	7' U.	S. 01	f R=24 Joint and 5.8'	TZ. MAN			MATION OF DRILL	
USAE-WES		-and	iward from river face		ine Sk		DISTURSES	U40157UR 850
DLE NO. IA.		*****	BR WES R-5-86	* au ài	DEN SAUP	OVER-	<b>u</b> i	
AME OF DRIL				-		R CORE B		
Dan Tav	lor			IS ELE	ATION G	OUNO WA		
RECTION OF		LINED	DES. FROM VERT.	S. DATE	E HOLE			24 Jan 86
				17. ELE	ATION TO	P OF HOL	. <b>c</b> 730.5'	
EPTH ORILLI						HECOVERY	FOR BORING RO	ock 99 1
TAL DEPTH			90.7'		et Mur			
-	TH L	GEND	CLASSIFICATION OF MATERIA	ALS	1 CORE RECOV- ERY	SAMPLE HO.	(Drilling time, was	RES or loca, depth of
<u></u>	<b>b_</b>		<del></del>		<u> </u>			
	$\exists \angle$	7						
1	<del>_</del>	<del></del>	MB - 2 pieces l' rebar	ar		<del></del>		
Ì	=		60.4'.					
	<u>,</u> #	$\Delta$			100			
61.	<del>"</del>	Ì						
	$\exists$					22		
		<del>-</del>						
	=	i						
62.	<del>م</del>							
		$\stackrel{\square}{=}$	:48			[	Run: 11	
	Ξ.		Concrete:				Begin: 62.	3'
	$\exists \angle$	7	Looks good, sounds go entrained air, entrap				End: 66.5' D.T.: 3 hr	00 min
1	<u>,</u> ⊐_	-	air, maximum size 1/2					24 <b>0</b>
63.	~						RPH: ≈ 100	
	$\exists$		MB Aggregate - siliced	nus and			Rec: 4.2' Loss: 0.1'	in hole
	===		calcareous, natural				Comments:	In noie
	∃,		crushed, max mum si		100			
64.	∠≒ہ	7	2-3/4".			-		
1	⇉	j						
	$\exists$	$\wedge$				23		
	$\exists$	-						
1	ℷ╡							
65.	ΞΖ	7						
1	$\exists$	Ì						
i i						i		
-	$\exists$	$\Delta$						
66.	ᆆ	1						
	7							
}	_=_	7						
1	$\Xi$							
	<u> </u>	$\triangle$						
67.	4	_ }					Run: 12 Begin: 66.	ς !
İ	17	~~					End: 71.6'	,
		a • a	MB Concrete rock inter	face.			D.T.: 2 hr	55 min
Ì	-		M <b>.8</b>	Ì		]	D. Presa:	240
68	-E		мв		98		RPM: ≈100 Rec: 5.1'	
	4=	==					Loss:	
1	#	==	мв	,				Reached
		==	Gray shale, moderate MB hard, slightly sandy				concrete -	
	73		with calcareous in-	"		24	interface. gray shale.	
69.	<u>-</u> ــــــــــــــــــــــــــــــــــــ	==	clusions.				Layer of gr	
	7-	==.					concrete an	d rock.
	_3=						Layer of bu	
1	==		мв				Cravel is s	
- 1	7=-	===					with a waxy	
70.	∩~							

Hele Ne 27 - ES R-5-60

DRILL	LING LOG	OIVISI	hio River	Monon	ganela	Kiver	OF 10 SHEET B
ROJECT	WEHOOT	litat	ion of Lock & Dam				60 Y 1/4"
	, Monongan		liver		JA FOR EL	EVATION	SHOWN /TEM - MELL)
	6.7' U.S.	of F	R-24 Joint and 5.8'	12. MARI	PACTURE	A-3 0431	NATION OF DRILL
RILLING	AGENCY 1	andwa	rd from river Pace	Fail	ing Jk	id Rta	
USAF-	-		### 8R WES R-5-86	13 TOT	AL HO. OF	OVER-	DISTURBED UNDISTURBED
			00-C-X 63W NO				
	Carlos				ATION G		
MECTIO	Taylor N of House			IE DAT	E HOLF		4760  COMPLETED
******	CAL		DES. FROM VERT.	<u></u>	VATION TO		3 Dec 85 : 24 Jan 86
-	-	DEN	57.5' concrete				
EPTH DR	ILLED INTO R	CK	23.2' shale		ATURE OF		
OTAL DE	PTH OF HOLE		90.7	Sco	et Mur		
EVATION	-	ND	CLASSIFICATION OF MATERIA	LS	RECOV-	SAMPLE HO.	REMARKS (Drifting time, major loos, depth of meathering, size, it eignificants
•	70.0		•		-:-	70.	Talland, 112, 11 significant
	′°°°					İ	
- [	##	≡и́мв				25	
!	<del></del>	≂μiχB Ξψi:ιΒ					
į	<del></del> _	<b>≕</b> :3	Calcareous inclu	sions.		<b>S</b>	
]	71.0]==	31					
1	/*·*===	31				]	
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t	====						
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ŀ	7	- i iB				1	End: 76.7'
1	73.0	===					D.T.: 2 hr 18 min
}	7	<b>三温</b>					D. Press: 240 RPM: =100
ĵ		<b>≅</b> ₩ <u>B</u>					Rec: 4.8'
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			DITIONS ARE OBSOLETE		PROJECT	===	ilitation of House No.
	IN IA PREV	OUS E	DITIONS ARE OBSOLETE			Kenab:	ILLICION OF THE MO.

Hale No. JR WES R-5-86

No. 2, Mononganela River  R. 23, 6.7' U.S. of R-24 Joint and 5.8'  R-23, 6.7' U.S. of R-24 Joint and 5.8'  DRILLING AGENCY Ididward from five Lace  USAE-WES  NOLE NO. (As some a ground sister)  BR WES R-5-86  IS TOTAL  SAME OF ORILLER  Dan Taylor  DIRECTION OF NOLE  MY CONTINUES  DEPTH DRILLED INTO ROCK  23.2' Shale  IS SIGNAT  TOTAL DEPTH OF NOLE  VAB  BI. 0  Gray Shale, Siliceous  With calcareous inclusions, moderately hard,  MB  Slightly Sandy.	ACTURE TO SK! NO. OF N SAMPL TION GR HOLE TION TO COME R TURE OF E MUT	R'S DESI	NOMES 32  STEP  STEP  B Dec 85 24 Jan 86  LE 730.5'  V FOR BORNER ROCK 99  OR  (Drilling rims, more been death of machinering, ories, 14 augmidiatemy)  Run: 15  Begin: 80.8'  End: 85.5'  D.T.: 2 hr 23 min  D. Press: 240
COCATION (Commence of Station)  REC-23, 6.7° U.S. or R-24 Joint and 5.8°  PRILLIPS AGENCY IMMUNICATION TIVEL LATE  USAE-WESS  DAN TAYLOR  MARKETOR OF DRILLER  DAN TAYLOR  MARKETOR OF MOLE  DEFTH OF MOLE  DEFTH OF MOLE  THICKNESS OF OVERSUADES  FOR STATION OF MOLE  PATION OF MOLE  TOTAL OFFTH OF MOLE  OFFTH OF MOLE  TOTAL OFFTH OF MOLE  OFFTH OF MOLE  TOTAL OFFTH OF MOLE  MARKETOR OF MOLE  OFFTH OF MOLE  OFFTH OF MOLE  OFFTH OF MOLE  OFFTH OF MOLE  TOTAL OFFTH OF MOLE  OFFTH OF MOLE  MARKETOR OF MOLE  OFFTH OFFTH OF MOLE  OFFTH OF MOLE  OFFTH OF MOLE  OFFTH OF MOLE  OFFTH OF MOLE  OFFTH OF MOLE  OFFTH OF MOLE  OFFTH OF MOLE  OFFTH OFFTH OF MOLE  OFFTH OF MOLE  OFFTH OF MOLE  OFFTH OF MOLE  OFFTH OFFTH OF MOLE  OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFFTH OFTH O	ACTURE OF MUSEL CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CORE R LONG CO	A S DESI	COMMITTION OF DRILL  IN   CHETURDED   UNDISTURBED  INTER   COMMITTED   S Dec 85   24 Jan 86  LE 730.5'  FOR BORNING ROCK 99  FOR REMARKS  (Drilling Issue, masses death of masses rich, if aspections)  Run: 15  Begin: 80.8'  End: 85.5'  D.T.: 2 hr 23 min D. Press: 240
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MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  MB  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1.0  B1	NUMBER TION GR HOLE TION TO COME R TURE OF L ECOME ERV ERV	POFNO ECOVER INSPECT	NOMES 32  STEP  STEP  B Dec 85 24 Jan 86  LE 730.5'  V FOR BORNER ROCK 99  OR  (Drilling rims, more been death of machinering, ories, 14 augmidiatemy)  Run: 15  Begin: 80.8'  End: 85.5'  D.T.: 2 hr 23 min  D. Press: 240
Dan Taylor Dan Taylor Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Direction of Note Directio	TION GR	OUND WA	Run: 15 Begin: 80.8' End: 85.5' D.T.: 2 hr 23 min D. Press: 240
THICKNESS OF OVERSUNGEN 67.5' CONCRETE 19. ELEVA PRINCESS OF OVERSUNGEN 67.5' CONCRETE 19. TOTAL DEPTH OF HOLE 90.7' SCOT CLASSIFICATION OF MATERIALS PARTIES  BI.O. MB  BI.O. MB  Gray shale. siliceous with caicareous inclusions, moderately hard, MB  83.0. MB  MB  84.0. MB  MB  84.0. MB  85.0. MB  MB  85.0. MB  MB  84.0. MB  MB  85.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB  MB  88.0. MB	TION TO	P OF HO ECOVER INSPECT TELL SOX ON SAMPLE HO.	Run: 15 Begin: 80.8' End: 85.5' D.T.: 2 hr 23 min D. Press: 240
MB  B1.0  MB  Gray shale, siliceous with calcareous inclusions, moderately hard, slightly sandy.  MB  83.0  MB  84.0  MB  MB  84.0  MB  MB  84.0  MB  MB  85.0  MB  MB  84.0  MB  MB  84.0  MB  MB  85.0  MB  MB  86.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  MB  88.0  MB  MB  MB  88.0  MB  MB  MB  88.0  MB  MB  MB  MB  MB  MB  MB  MB  MB  M	COME NUMBER OF	POP HOPECOVER INSPECT	Run: 15 Begin: 80.8' End: 85.5' D.T.: 2 hr 23 min D. Press: 240
TRUCKESS OF OVERSUNGEN 67.5' CONCRETE 19. TOTAL OPETH OF HOLE 90.7' SCOT CLASSIFICATION OF MATERIALS WITH CALCAR COLUMN WITH CALCAR COLUMN WITH CALCAR COLUMN SIGNS, moderately hard, slightly sandy.  82.0 MB  84.0 MB  85.0 MB  86.0 MB  86.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB  88.0 MB	COME N	ECOVER INSPECT Tell BOR ON SAMPLE NO.	RUN: 15 Begin: 80.8' End: 85.5' D.T.: 2 hr 23 min D. Press: 240
MB  B1.0  MB  Gray shale. siliceous with calcareous inclusions, moderately hard.  S2.0  MB  MB  83.0  MB  MB  84.0  MB  MB  85.0  MB  MB  85.0  MB  MB  88.0  MB  MB  88.0  MB  MB  MB  88.0  MB  MB  MB  88.0  MB  MB  MB  MB  MB  MB  MB  MB  MB  M	E COME	INSPECT	Run: 15 Begin: 80.8' End: 85.5' D.T.: 2 hr 23 min D. Press: 240
MB  S1.0  MB  Gray shale. siliceous with calcareous inclusions, moderately hard, slightly sandy.  MB  83.0  MB  MB  84.0  MB  MB  85.0  MB  MB  85.0  MB  MB  85.0  MB  MB  85.0  MB  MB  86.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0  MB  MB  88.0	E COME	BOX OR SAMPLE	Run: 15 Begin: 80.8' End: 85.5' D.T.: 2 hr 23 min D. Press: 240
MB  B1.0  Gray shale, siliceous with calcareous inclusions, moderately hard, slightly sandy.  MB  83.0  MB  MB  84.0  MB  67ay shale, moderately, hard, slightly sandy, MB  81.0  Gray shale, moderately, hard, slightly sandy, MB  81.0  MB  88.0  MB  88.0	•		Run: 15 Begin: 80.8' End: 85.5' D.T.: 2 hr 23 min D. Press: 240
MB  B1.0  Gray shale, siliceous with calcareous inclusions, moderately hard, slightly sandy.  MB  83.0  MB  MB  84.0  MB  67ay shale, moderately, hard, slightly sandy, MB  81.0  Gray shale, moderately, hard, slightly sandy, MB  81.0  MB  88.0  MB  88.0	•		Run: 15 Begin: 80.8' End: 85.5' D.T.: 2 hr 23 min D. Press: 240
MB  S1.0  Gray shale. siliceous with calcareous inclusions, moderately hard, slightly sandy.  MB  MB  MB  84.0  MB  MB  67.0  MB  MB  67.0  MB  Gray shale. moderately, hard. slightly sandy, siliceous with calcareous MB inclusions.  MB  MB  88.0  MB  88.0	100	29	Begin: 80.8' End: 85.5' D.T.: 2 hr 23 min D. Press: 240
Gray shale, siliceous with calcareous inclusions, moderately hard, slightly sandy.  MB  MB  MB  MB  MB  MB  Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  MB  MB  MB  MB  MB  MB  MB  MB  M	100	29	Begin: 80.8' End: 85.5' D.T.: 2 hr 23 min D. Press: 240
Gray shale, siliceous with calcareous inclusions, moderately hard, slightly sandy.  MB  MB  MB  MB  MB  MB  Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  MB  MB  MB  MB  MB  MB  MB  MB  M	100	29	Begin: 80.8' End: 85.5' D.T.: 2 hr 23 min D. Press: 240
Gray shale, siliceous with calcareous inclusions, moderately hard, slightly sandy.  MB  MB  MB  MB  MB  MB  Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  MB  MB  MB  MB  MB  MB  MB  MB  M	100	29	Begin: 80.8' End: 85.5' D.T.: 2 hr 23 min D. Press: 240
With calcareous inclusions, moderately hard, slightly sandy.  MB  MB  MB  MB  MB  MB  MB  Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  MB  MB  MB  MB  MB  MB  MB  MB  M	100	29	D.T.: 2 hr 23 min D. Press: 240
sions, moderately hard, slightly sandy.  MB  83.0  MB  84.0  MB  85.0  MB  Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0	100		D. Press: 240
MB  83.0  MB  84.0  MB  85.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0	100		
MB  83.0  MB  84.0  MB  85.0  MB  Gray shale, moderately, hard, slightly sandy, sliceous with calcareous MB inclusions.  MB  88.0  MB  88.0	100		RPM: ≈100
MB  84.0  MB  85.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0	100		Rec: 3.7'
MB  84.0  MB  85.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0	100	1	Loss: 1.0'
MB  84.0  MB  85.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0			Comments: Seam still
MB  84.0  MB  85.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0			present.
MB  84.0  MB  85.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0			
MB  86.0  Healed fracture.  86.0  MB  Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0			
MB  86.0  Healed fracture.  86.0  MB  Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0			
MB  85.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0	i	i	
MB  85.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0	- }		
MB  85.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0	}	30	
MB  85.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  88.0  MB  88.0	1		
Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  MB  88.0	ļ		
B5.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  88.0	ŀ	.	
B5.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  88.0	- 1		
B5.0  Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  88.0	]		
Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  MB  88.0	Ī		
Healed fracture.  MB  Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  MB  88.0	1		i.
Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  88.0	1		Run: 16
Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  88.0	}		Begin: 85.5°
Gray shale, moderately, hard, slightly sandy, siliceous with calcareous MB inclusions.  MB  88.0		İ	End: 89.6
Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  88.0			D.T.: 2 hr 10 min D. Press: 2.0
Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  88.0	j		RPM: ≈100
Gray shale, moderately, hard, slightly sandy, MB siliceous with calcareous MB inclusions.  MB  MB	Ì	31	Rec: 4.7'
hard, slightly sandy, MB siliceous with calcareous MB inclusions. MB	Ì		Loss: 0.4°
hard, slightly sandy, MB siliceous with calcareous MB inclusions. MB	ļ		Comments: Seam still
MB siliceous with calcareous MB inclusions.  MB  MB  88.0	1		present.
MB inclusions.  MB  MB	}		
MB MB	100		
88.0	ļ		
88.0	ł		
88.0	ļ		
	}	i	
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90.0			
FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.			

B75

Hele Ne. BR WES R-5-86

· DRILLING	FOC ,	Ohio River	Monor	ganela	Rive:	Dam No. 4, SHEET 10 OF 10 SHEETS			
PROJECT	Rehabil	itation of Lock & Dam	10. SIZE	AND TYP	OF BIT	4" Y 7 7/4"			
'No. 2, Mo			II. DATE	IN FOR EL	EVATION	SHOWN (TEM - MELL)			
R-23, 6.7	U.S.	of R-24 Joint and 5.8'	12. 1AN	FACTURE	M'S DESIG	GNATION OF DRILL			
USAE-WES		ndward from river face	ليوعيا	ina Sk	id Riv	DISTURBED UNDISTURBED			
HOLE NO. (As a		BR WES R-5-86	SUR!	IS, TOTAL NO. OF OVER- DISTURSED UNDER SAMPLES TAKEN					
NAME OF DRILL	. <u>E</u>	:		AL HUMBE					
Dan Tavl			IS ELE	VATION G		RTED   COMPLETED			
DIRECTION OF		D DEA. FROM VENT.	IL DATE	E HOLE		3 Noc 85 24 Jan 86			
THICKNESS OF				ATION TO	P OF HO	LE -10.5'			
DEPTH DRILLE			19, 707	ATURE OF	ECOVER	Y FOR BORING ROCK 99 1			
TOTAL DEPTH	0F HOLE	90.71	1	t Murr					
EVATION DEP	TH LEGEN	CLASSIFICATION OF MATERIA			BOX OR	REMARKS (Drilling time, water lane, depth of measuring, old., if eignificant			
<u> </u>		4		ERY	NO.	seasonne, etc., il espellaces			
70.0		Gray snale, siliceo		100		Run: 17			
1	<b>====</b>	with calcareous inc moderately hard, sl		•		Begin: 89.6			
'		sandy E.O.B. @ 90.7				End: 90.7 D.T.: 245 min			
	7===	748			<b></b>	D. Press: 240			
1.	7				]	RPM: 7-100			
	$\exists$					Rec: 1.5'			
	E					Comments: Clutch broke			
	$\exists$					on drill rig. Aban-			
	$\exists$		i			doned hole at 90.7'			
-	7					depch.			
	$\exists$								
-									
	$\exists$								
	⇉								
	7								
_	3								
-	Ε					Abbreviations:			
l	⇉	l			. !	D.T.: Drill Time			
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(Drilling time, mores love, domin of membering, etc., if e-graticami CLASSIFICATION OF WATERIALS ELEVATION DEPTH LEGENS Surface intact Δ Concrete good, natural and crushed siliceous aggregate, maximum size 1-1/2 in. Box 1/2 in. rebar 100 Δ Has entrapped and entrained air tadanhadanhadadanhadadadadada ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. Dam 2. Mon. River BR WES R-7-80

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APPENDIX C: PETROGRAPHIC REPORT, CONCRETE

Corps of Engineers, USAE Waterways Experiment Station	Concrete Report	Structures Laboratory P. O. Box 631 Vicksburg, Mississippi
Project Examination of Monongahela River	Concrete, L/D #2	Date 15 March 1988

### Samples

- 1. Twenty-one cores were taken from the concrete at Locks and Dam No. 2 on the Monongahela River. One core was drilled into the backfill area beyond the concrete esplanade.
- 2. Nine of the cores were taken from horizontal holes. The remaining twelve cores were taken from vertical holes. Five of the vertical cores were drilled through concrete and into foundation rock. The cores are identified in Table 2 (with Cores Received Section).

### Test procedures

3. All of the material from the twenty-one cores was examined in the field and again in the laboratory. The quality and condition of both the concrete and the foundation rock were noted. Representative samples of both material types were selected for more detailed examination and testing. Pieces of concrete that contained visible evidence of poorer-quality or significant reaction products were specifically chosen. The concrete samples examined in detail are identified below:

Field Id.	Orientation in Wall	Depth of Sample	Concrete Technology Division Serial No.
L-1	vertical	0.0- 3.15-ft	Pitts-13 CON-1
L-6	horizontal	1.2- 1.40-ft	Pitts-13 CON-12
L-7A	vertical	39.5-43.1-ft	Pitts-13 CON-29
M-1	vertical	32.6-35.75-ft	Pitts-13 CON-51
M-2	horizontal	0.0- 1.0-ft	Pitts-13 CON-60
M-5	horizontal	0.0- 3.3-ft	Pitts-13 CON-63
R-1	vertical	0.0- 1.65-ft	Pitts-13 CON-110
R-4	horizontal	0.0- 3.1-ft	Pitts-13 CON-112
R-5	vertical	31.0-33.2-ft	Pitts-13 CON-97

4. Samples for physical tests of the concrete were taken from both sound and poorer quality material. This was done to obtain the information on the "best case" and "worst case" material in order to ascertain just how bad the "bad" concrete was.

C2

- 5. Samples from six of the cores were cut, ground smooth, and photographed. They were examined both visually and with the aid of a stereomicroscope.
- 6. The exterior surface of cores Pitts-13 CON-1, CON-60 and CON-112 were photographed.
- 7. A sawed slab from the top portion of sample Pitts-13 CON-112 was etched in dilute hydrochloric (HCL) acid to expose reaction rims present on some of the coarse aggregate. The etched surface was then examined both visually and with a stereomicroscope.
- 8. Cement paste concentrates were prepared from all six core samples. These were examined as tight-packed powder samples by X-ray diffraction (XRD).
- 9. Fine-grained white material was noted at the border of a piece of porous limestone coarse aggregate in sample Pitts-13 CON-112. The aggregate was located in a preexisting fracture surface. A small portion of the powder was collected and examined by XRD; the aggregate and surrounding paste were photographed.
- 10. Representative pieces of each coarse aggregate type were selected and examined by XRD.
- 11. Thin sections from four cores (Pitts-13 CON-1, CON-29, CON-60, and CON-112) were prepared and examined using a polarizing microscope. The thin sections were chosen from areas of the cores that represented typical concrete. Sections from cores Pitts-13 CON-60 and CON-112 contained coarse aggregate with rims.
- 12. All X-ray diffraction patterns were made using an X-ray diffractometer with nickel-filtered copper radiation. Results
- 13. The concrete placed at the lower elevations in the three lock walls was easily distinguished from the concrete placed at the upper elevations. Aggregate used in the concrete at lower elevations was natural river sand and gravel with well rounded edges. Photograph Cl represents concrete placed at the lower elevations in all three walls. The natural river gravel was composed of coarse and fine-grained sandstone, siltstone, igneous and gneissic rock particles and some carbonate rock. Some of these particles were fractured, and several had either reaction or weathering rims. A few particles has siderite cores with a rim of geothite. The fine aggregate consisted of a

mixed composition. The mineral composition of eight typical coarse aggregates is shown in Table Cl.

- 14. The concrete paste in the lower elevations of all three walls was a dark grayish color, except in areas where carbonation had occurred. The concrete is air-entrained and contains some entrapped air voids (voids >1 mm in diameter). No cracks were noted in the paste.
- 15. A general description of the concrete from the upper level each wall follows:

## Land Wall Cores

- 16. The concrete placed at the upper elevations in the land wall (Pitts-13 CON-1, CON-5, CON-10, CON-12, and CON-29) was made using crushed limestone coarse aggregate and a natural, mixed composition fine aggregate. The coarse aggregate was a dense, dark colored material, consisting of calcite and trace amounts of clay (Table Cl). No reaction rims were noted in this aggregate (Photograph C2).
- 17. The concrete paste in the upper elevations of the land wall was a dark grayish color, except for areas where carbonation had occurred (Photograph C2). It was air-entrained and contained some entrapped air. No cracks were noted. Photograph C3 shows the surface concrete condition at boring L-1 (Pitts-13 CON-1). The surface concrete of the other borings in the land wall was similar.

### Middle and River Wall Cores

18. The concrete at the upper elevations of the middle and river walls was made using natural river gravel as coarse aggregate and a natural, mixed composition fine aggregate. The predominant rock type was dolomite, with some particles of igneous and metamorphic rock. The dolomite had well rounded edges, reaction rims (Photograph C4), and some weathering rims. Horizontal cores taken from above the upper pool level in both locks had good exterior surfaces; no cracking was noted. Hairline cracks in both paste and aggregate were present to a depth of approximately 0.4-ft in cores Pitts-13 CON-60, CON-110, and CON-112. Cores Pitts-13 CON-60 and CON-112 were taken from below the upper pool level on the land face of the middle wall and the land face of

the river wall, respectively. The exposed surfaces of these two cores were moderately weathered with exposed aggregate. Photograph C5 shows the condition of the Pitts-13 CON-112; CON-60 was similar.

- 19. The concrete paste in the upper elevations of the middle and river walls was a light gray color. Entrained and entrapped air were present.

  Concrete from boring M-1 (Pitts-13 CON-51) contained entrained air although it was reported in the field logs that it was not air-entrained.
- 20. The slab of concrete from core Pitts-13 CON-112 that was etched in dilute  $HC\ell$  showed that the rimmed areas on coarse dolomite aggregate dissolved at the same rate as the nonrimmed areas.
- 21. The paste concentrates of cores Pitts-13 CON-1, CON-29, CON-51, CON-60, CON-110, and CON-112 showed similar compositions by XRD. Calcium silicate hydrate (C-S-H), calcium hydroxide (CH), ettringite, and tetracalcium aluminate carbonate-11-hydrate (monocarboaluminate) phases of hydrated portland cement were present in each sample. Hydrogarnet was also identified in Pitts-13 CON-29. Unhydrated portland cement was detected by XRD in the paste concentrates, occurring as one or more of the calcium aluminoferrite solid solution series.
- 22. The white powder found around the coarse aggregate (Photograph C6) in sample Pitts-13 CON-112 contained calcium carbonate as three different minerals; calcite, aragonite, and vaterite. No other crystalline phases were identified in the powder.
- 23. Table Cl gives the mineralogical data for several coarse aggregates examined by XRD. The sandstones examined from concrete in lower elevations contained mainly quartz, feldspar, mica, and clays. One igneous particle also contained a monoclinic amphibole. The dark, dense, crushed limestone rock used in the upper elevations of the land wall was mainly calcite. A trace of clay mica was also present. The brownish coarse carbonate rock used in the upper elevations of the middle and river walls contained a large amount of dolomite. In every case but one, the carbonates (calcite and dolomite) were about equal in amount, or there was more dolomite. Clay was also present in these rocks.
- 24. The examination of petrographic thin sections made from four concrete samples showed both normal hydrated cement paste with C-S-H and CH present, and paste that was highly carbonated. The amount of CH present in the concrete was fairly high for areas that were not carbonated. Isotropic

material that was probably C-S-H gel was abundant in the paste. Unhydrated portland cement was identified in the thin sections as calcium silicates and calcium aluminoferrites. The sections made from samples Pitts-13 CON-60 and CON-112 showed coarse aggregate with euhedral and subhedral crystals of dolomite in a fine-grained calcite matrix. The section made from sample Pitts-13 CON-112 had a portion of the large aggregate seen in the lower center of Photograph C4. The rock has a reaction rim, but no visible damage or reaction product at the rock-paste interface was found in the thin section.

# Discussion

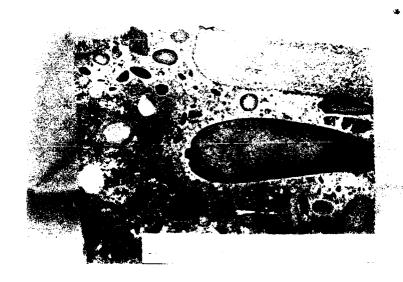
- 25. In general, the concrete in the three lock walls appears to be in good condition and is competent. The damaged concrete is confined to the lock walls below the upper pool level, and this is minor.
- 26. The damaged areas are in the exposed ends of the horizontal cores taken from areas below the upper pool level in the locks. The damage consisted of etched surfaces, leaving aggregate exposed, and as hairline cracks normal to the direction of coring that extended to a depth of 0.4-ft. The etching is probably due to chemical action.
- 27. The XRD results of examination of paste concentrates and the examination of thin sections using a polarizing microscope showed that some carbonation of the paste had occurred. The extent of carbonation is minor, except in areas near the surface of lock walls where the carbonation occurs mainly as calcite. Some carbonation has occurred throughout the paste as indicated by the presence of monocarboaluminate. The resulting hairline cracks may be due to this carbonation of the paste causing carbonation shrinkage.

Table Cl

Mineralogical Composition of Selected Coarse Aggregate from

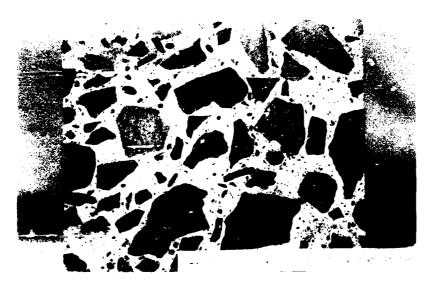
Locks No. 2 Concrete by X-ray Diffraction

		Sample Identification						
	<del>-</del> 1	29	29	Pitts-1 51	3 CON- 60	60	110	112
Minerals	Agg. 2	1	4	1	1	2	2	2
Clays								
Kaolinite	X	X					Х	Х
Clay-Mica	Х	Х		х	х	X		Х
14A Material		X						
Nonclays								
Quartz	X	X		x		X	X	X
Feldspar		X						
Mica		x						
Calcite	X			X	X	X	Х	х
Dolomite				x	x	x	х	Х
Siderite			Х					
Goethite			х					



PITTS -13 CON - 29

Photograph Cl. Concrete from L-7A. The coarse aggregate is mainly coarse and fine-grained sandstone. The dark particle near the lower center has a rim of goethite and a core of siderite. The dark rims are mainly weathered rims. Some rims are reaction rims



11TS-13 CON- 1

Photograph C2. Concrete from L-1. The coarse aggregate is crushed limestone. No reaction rims are present



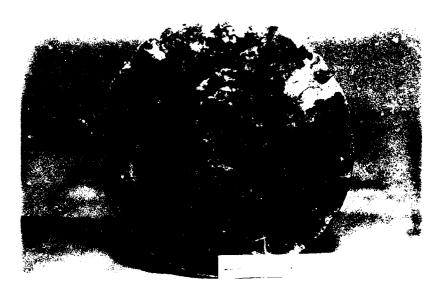
PITTS -13 CON - 1

Photograph C3. Surface concrete at L-1. The surface concrete is in good condition



ciTTS-13 CON-112

Photograph C4. Concrete from R-4. Hairline cracks are through coarse aggregate and paste. Note the reaction rim around the aggregate at the bottom center. The texture of this aggregate is crystalline dolomite with a matrix of fine-grained calcite



PITTS -13 CON - 112

Photograph C5. Concrete from R-4. This shows the surface concrete in the lock walls. The surface has been etched. Coarse aggregate is exposed



Photograph C6. Concrete from R-4. Note the white powder around the coarse aggregate. The composition of the powder is calcite, aragonite, and vaterite

APPENDIX D: PETROGRAPHIC REPORT, RIVER SEDIMENTS AND FOUNDATION ROCK

Corps of Engineers, USAE Waterways Experiment Station	Petrographic Report	Structures Laboratory P. O. Box 631 Vicksburg, Mississippi
Project Examination of R Dam No. 2, Monongahela Ri		Date 1 December 1986

## Samples

1. Six cores were drilled into foundation material at the site; two of these cores were drilled through backfill material beyond the land wall. This material was received at the Structures Laboratory (SL) on 26 February 1986. Descriptions of the material received are shown below:

Field Location and Id.	CTD Id. No.	Sample Types
Land Wall Backfill BR WES L-2	Pitts-13 DC-1 to DC-18	Slag and gravel backfill. Blue- gray, brown, and gray shale; soft to mod. hard.
Land Wall Backfill BR WES L-5	Pitts-13 DC-19 to DC-33	Slag, steel, gravel, and clay backfill. Blue-gray, brown, and gray shale; soft to mod. hard.
Land Wall BR WES L-7A	Pitts-13 DC-34 to DC-53	Shale, gray and red, soft to mod. hard. Gray shale, silty, mod. hard to hard.
Middle Wall BR WES M-1	Pitts-13 DC-54 to DC-65	Gray shale, soft to mod. hard. Brown shale, soft to mod. hard. Red and gray shale, soft to mod. hard.
Middle Wall BR WES M-6	Pitts-13 DC-66 to DC-75	Gray shale, silty, mod. hard.
River Wall BR WES R-5	Pitts-13 DC-76 to DC-84	Gray shale, silty, mod. hard.

Samples representing three types of shale, distinguished by color, were selected for testing from the six cores.

## Test Procedures

2. All of the cores were inspected in the laboratory, and hand samples were taken to verify field descriptions. Each sample was then inspected visually and with a stereomicroscope to determine physical characteristics.

- 3. A portion of each rock type sample was air dried, ground to pass a  $45-\mu m$  (No. 325) sieve, and examined by X-ray diffraction (XRD).
- 4. Two sedimented slides of clay-sized material (<2  $\mu$ m e.s.d.\*) were made from the samples containing predominantly clay minerals. Both slides were examined by XRD following air drying. One slide was X-rayed again after saturation with glycerol. The remaining slide was heat treated at 350°C for one hour to dehydrate clay minerals and examined by XRD in a static nitrogen atmosphere in order to prevent rehydration of the clay minerals during examination.
- 5. An X-ray diffractometer with nickel-filtered copper radiation was used for all XRD work.

### Results

- 6. <u>Blue-gray shale</u>. The sample consisted of bluish-gray (dusky blue-green, 5 BG 3/2) (The Rock Color Chart Committee 1975)\*\* shale that was soft to moderately hard, moderately weathered, and very fine grained (<0.1 mm) (Headquarters, US Army Corps of Engineers (HQUSACE) 1975). The rock contained numerous healed horizontal fractures and an open vertical joint. Some areas contained calcareous nodules and iron staining. Major mineral constituents of the rock were quartz, plagioclase feldspar, and clays. The clay minerals present were kaolinite, clay-mica, chlorite, and vermiculite.
- 7. Brown shale. This sample consisted of a moderate brown (5 YR 3/4) (The Rock Color Chart Committee 1975) shale that was soft to moderately hard, slightly weathered, and very fine grained (<0.1 mm) (HQUSACE 1975). The rock contained numerous open horizontal fractures and occasional calcareous nodules. Major mineral constituents of the sample were quartz, plagioclase feldspar, and clays. The clay minerals identified were kaolinite, clay-mica, chlorite, and vermiculite.
- 8. Gray shale. By far the most abundant of the three rock types, this sample was an olive gray (5 Y 4/1) (The Rock Color Chart Committee 1975), silty, moderately hard to hard shale. It was slightly weathered and very fine grained (<0.1 mm) to fine grained (0.1-0.4 mm) (HQUSACE 1975).

<sup>\*</sup> Equivalent Spherical Diameter

<sup>\*\*</sup> See References at the end of the main text.

It remained intact when submerged in water. The rock had some iron staining and contained numerous calcareous nodules. Major mineral constituents were quartz, plagioclase feldspar, and clay minerals. The clay minerals present were kaolinite, clay-mica, chlorite, and vermiculite.

9. The mineral composition of all three samples is shown in Table 1.

Table 1
Mineralogical Composition of Three Samples by X-Ray Diffraction

	Blue-Gray	Brown	Gray
Constituents	Shale	<u>Shale</u>	Shale
Quartz	X	X	X
Plag. Feldspar	X	X	X
Kaolinite	X	X	X
Clay-Mica*	X	X	x
Chlorite	X	X	x
Vermiculite	X	X	Х

<sup>\*</sup> Clay-sized mica.